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CAVALRY: HOW FAR ITS EMPLOYMENT IS AFFECTED BY RECENT IMPROVEMENTS IN ARMS OF PRECISION.

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THE subject selected for this afternoon's lecture is the future employment of cavalry with reference to the improvements in the construction and practice of artillery and small arms.

This subject involves a great deal; and during the short time at our disposal in the present lecture, I can attempt nothing more than a rough sketch—a mere outline—of what my own opinions are, and also what I conceive to be the opinions of many whom I have consulted, and many whose works I have read. I must leave out the details, and merely give an outline of the subject.

I shall, in the first place, read two short extracts from a work published in New York in 1863, entitled "The Employment of Cavalry—"its History and Management," by J. Romer, LL.D. The author is speaking of rifled cannon and small arms, and states:—

"Elsewhere we shall have occasion to examine the qualities of these new engines of destruction, and the extent to which they are likely to affect the usefulness of cavalry. For the present, let it suffice to remark that the question has been promptly resolved by those most interested in it, for all investigations to ascertain whether the recently tried effects of the modern fire-arms justify the opinion that mounted troops will henceforth be unavailing, concur in the conclusion that hereafter cavalry will be more indispensable than ever, and that nothing should be neglected that can render it more efficient by either mounting it on better horses, or developing the individual instructions of the soldier, or both."

Under the head of the *cavalry charge*, we find the following in the same work:—

"It is not then that the fire of infantry is much to be feared, whether armed with rifles or with old smooth muskets, whereas the improvements of artillery all favour cavalry. Horse artillery now moves with almost equal speed, and acts in concert with the latter, while formerly these laboured alone. With such powerful auxiliaries, cavalry are unquestionably more formidable than before, and with horse artillery they must always destroy infantry, however good and tried it may be, for even, though the cavalry alone may effect nothing against them, the artillery will shatter them while they keep together, and when they attempt to deploy they must fall a prey to the horsemen. Thus, if the improved tactics of infantry have given them an advantage over the cavalry, the latter are even greater gainers by the improvement of the artillery, which, by accompanying them, affords them those favourable occasions, when to dare is to conquer."

Here we have the American opinion upon this subject; and as America has been the theatre of cavalry warfare in a certain phase, the opinion may be considered so far valuable.

The subject we have to deal with seems naturally to divide itself into three heads. In the first place, what have been the improvements in latter years in arms of precision? In the second place, what are likely to be the effects of these improvements? And, in the third place, what will be the best means of neutralizing or counter-balancing the great superiority which the practice of arms of precision seems to have gained in the present day all over the civilized world?

I shall now ask your attention for a few moments while I read a short extract from a well-known work of the present day, by an Officer of our own Artillery, well-known to military readers—Colonel Hamley—on "The Operations of War." I take this course, because, in the first place, I think it will save time, as Colonel Hamley conveys my own opinions, and what I believe to be the opinions of many others, more clearly and concisely than I could do it myself: in the second place, Colonel Hamley is an Artillery Officer, therefore, he may be considered more competent to judge of the improvements, and the consequent effects of such improvements, in his own branch of the service: and in the third place, Colonel Hamley's work has become, to a certain extent, an authority. His reasoning, conclusions, and illustration of facts, have not, as far as I know, been contradicted; therefore, I think his statements may be taken to convey generally the opinions of those professionally cognizant of the subject, at least as far as regards artillery matters.

The extract is as follows:—

"The introduction of arms of precision was the signal for numerous speculations, many of them somewhat extravagant, on the changes in warfare which would ensue. Some said all attacks would be impossible; some, that artillery would now be the chief arm, and infantry and cavalry mere escorts for the batteries; some, that the day of cavalry was over. This is by many degrees the most important question that can occupy the thoughts of contemporary soldiers, for it was by divining the relations between new systems and old, that Frederick and Napoleon rendered Prussia and France each for a time supreme in war. To discern and provide for the new conditions under which armies will engage, may, in the next European war, be worth to a people not merely armies and treasure, but liberty and national life.

"The first thing to be noted, is that the changes are not radical, like the introduction of artillery or of light infantry, but are only modifications of previously

existing conditions. To estimate the extent of these modifications will be an important step towards anticipating their influence on future military operations.

"The fire of infantry has extended its effective range from less than 200 to 600 or 700 yards. At 200 yards it is twice, at 400, six times, as effective as formerly.

"The effective fire of rifled artillery is extended from 1,200 or 1,400 to 2,000 or 2,500 yards.

"At first sight it would indeed seem that an advance against a line delivering such a fire would be impossible. But there are many circumstances to modify this conclusion.

"First. The calculation of the efficacy of rifle fire is based on the practice made by men firing singly at targets. File or platoon firing is very inferior in effect.

"Secondly. From 150 yards downwards, the fire of infantry, and from 1,100 yards downwards, the fire of artillery, is not more destructive to troops than formerly.

"Thirdly. In action, numerous circumstances lessen the effect of rifled arms. The adjustment of the weapon must be constantly changed in firing on an approaching object; and within the ranges of the old musket and the old field gun, the new arms are not more effective than their predecessors. Therefore, while within those ranges the effect is not increased; beyond them, the effect of fire on moving bodies is uncertain.

"Again, in almost all districts there are hollow ways and dips in the ground which may shelter troops even in what, at first, may seem to be a plain. Finally, the smoke of artillery and musketry, to which dust or fog may often be added; and the stress, moral and physical, of sustained conflict, are all of them influences which greatly diminish the effect of weapons requiring a clear range and a deliberate adjustment."

Elsewhere Colonel Hamley says:—

"It is argued that cavalry, always helpless when opposed to fire, will now receive such a storm of projectiles as will destroy it while still at a distance from the enemy.

"True as this may be of cavalry stationary in column, or moving uncovered on a flank, or halting to form for attack, it does not apply to the attack itself. Swiftness of movement is more than ever important, in passing over the region swept by fire, to close with the enemy. Cavalry can with ease move over 1,000 yards, ending with a charge, in 3¾ minutes. The speed of its motion would insure it against numerous or accurate discharges either of guns or infantry. Closing with the adverse line, it would have no more to fear from rifles than from muskets; and good cavalry has seldom been repelled by fire alone, but rather by the steady aspect of the serried line.

"One of the conditions under which artillery must exert its increased power of manœuvring, is association with cavalry. On the efficacy of the cavalry, therefore, must depend, in great degree, the efficacy of the artillery. But when associated thus, cavalry is no longer helpless against fire; the combined force can both attack and defend itself. Such companionship, then, is more than ever important."

Again:—

"Let us grant that cavalry will, in certain cases, suffer more than formerly. But as Napoleon used to say, omelettes cannot be made without the breaking of eggs. The losses must be compensated by increased efficiency, exhibited in power of manœuvring and determination in attack. Let us grant also that *bad* cavalry, when the lines are about to close, had better get out of the way; that merely *respectable* cavalry will, while supporting the other arms, effect nothing that can be considered decisive of a battle. But let it also be granted that cavalry, properly trained and led, may play as great a part as ever on the stage of war. Combined with new and larger proportions of artillery, its action may be decisive of the fate of battles; and launched in pursuit of a broken foe, it may finish a campaign which would else wade through fresh carnage to its woeful end.

"It will often happen that cavalry will best take advantage of sheltering ground by forming close column. But when exposed, it must deploy; and the general formation for manœuvre, which is supported by the most logical advocacy, is that of échelons of not less than squadrons. Whether there shall be one rank or two, one line or two, or in what manner the lines shall support each other, are questions for members of that part of the service to decide."

I shall now sum up and state shortly what I conceive to have been the purport of the extract which has just been read:—

I. *On the Nature of the Improvements.*

1st. A more extended range, obtained by substituting the rifled bore for the smooth bore.

2nd. Greater accuracy of aim, obtained by the adoption of improved modes of adjustment.

II. *Effects of the Improvements.*

1st. Impossibility of assembling the cavalry without protection at a distance within which they would formerly have been safe from the action of the enemy's artillery.

2nd. Impossibility of forming as formerly in the open ground out of range, and then advancing in attacking order to the assault.

III. *Best modes of Neutralizing or Counter-balancing such Effects.*

1st. To assemble the cavalry under protection of accidents of the ground from the view of the enemy, and from the fire of his artillery.

2nd. To form on the open ground in fighting order on a moving base, thus affording no standing mark to the enemy's artillery.

3rd. To support the formation and advance of the cavalry by the action of the horse artillery till arrived within attacking distance.

It is evidently with the last heading that we have to do at present.

First, then, to assemble the cavalry under protection of accidents of the ground from the view of the enemy and the fire of his artillery.

The assemblage of a body of cavalry, even of considerable force, within a distance of 2,500 or 3,000 yards of the enemy's position, under the protection of accidents of the ground, should not, under ordinary circumstances, be attended with much difficulty. There is hardly any ground upon which regular troops may be called upon to act, where shelter, either natural or artificial, cannot be found within the distance mentioned. Ground which, to the unpractised eye, may appear a level plain, will be found, upon inspection, to consist of slight and almost imperceptible undulations and dips, which will be found sufficient for the purpose required. This reminds me of a circumstance which occurred many years ago. The regiment to which I then belonged (the 15th Hussars), formed part of a brigade during

a field-day, under the divisional command of a General Officer now present. At the commencement of the field-day, the General, turning to an officer in command of a Cavalry regiment and some guns, ordered him to take up a certain position, but to conceal his force from the view of the enemy, supposed to be posted at a certain distant point. The Officer, with a look of astonishment, said it was impossible, as we were surrounded by an open plain; but it was soon pointed out to him, that by taking advantage of a very slight and almost imperceptible undulation of the ground which had escaped his notice, but had been detected by the practised glance of the General, he could place the horizon line between his own force and the enemy, and thus carry out the order he had received; this was the first practical illustration I had witnessed of this valuable appreciation of ground, and I have never forgotten it since. In all average ground certain accidents are to be found, scarps, ravines, villages, woods, walls, large buildings, even underwood and standing corn, if advantageously situated on a slight elevation, will be found to afford the protection required; for it must be recollected that if the cavalry can be brought up to their ground, and formed without being exposed to the view of the enemy, the point of assembly will be unknown, and consequently the range cannot be obtained. Districts doubtless do exist in certain parts of the world where actual level plains, without an accident or undulation for miles, are to be found, where, as far as the eye can reach, there is neither rock, tree, nor cover of any kind; but even on these level and unbroken plains there are certain elements existing, which might be taken advantage of to facilitate the assemblage of troops.

There is no time to discuss this point at present, but as far as regards the action of regular troops at the present day, these cases may be fairly considered as exceptional; the more particularly as the improvements in artillery and small arms with which we have to contend, have not as yet penetrated into the countries where these districts exist. We may therefore assume with Colonel Hamley, that in all European or civilised countries in which our troops may be called upon to act, the protection required for the assemblage of our cavalry will be found.

At this point Colonel Hamley states, "Whether there should be one rank or two, one line or two, or in what manner the lines should support each other, in short all questions relating to the actual details of cavalry movement and organization, are questions for members of that part of the service to decide." And from this point, I propose that we should take up the consideration of the subject.

Assuming the possibility of massing or assembling our cavalry in a protected locality, the next problem to be solved is, how are they to be extricated from such a position, and brought on to the open ground where the offensive action of cavalry properly commences, rapidly, smoothly, and steadily, without involving that disorder which must prove fatal to all cavalry movement and action?—how are they then to be formed on the open ground under the fire of the enemy to which they will be exposed in consequence of the increased range

and accuracy obtained by modern improvements in artillery practice, without subjecting them to that murderous fire, which would render all efficient formation impossible, if attempted according to the old system?—and how are they to be brought up to the scene of action under the protection of the artillery in battle array or fighting order with unbroken ranks ready to deliver the assault?

From this point they will be under no greater disadvantages than formerly; and for the charge we must only trust, as in the old times, to the gallant leading of our officers, the good riding and pluck of our men, the training and spirit of our horses, and the blessing of God upon our cause. This has not failed us in the past, and please God, it will not in the future.

This idea which I have just brought before you of the cavalry onslaught, as it was called in the old times, is the idea which rouses the old chivalrous feeling in our hearts, and makes the cavalry service so fascinating and attractive. The ringing of spurs and scabbards, the gleaming of swords and helmets, the rush of horses, the shock of the charge, and all the "pomp and circumstance" of a cavalry attack,—this is the idea which rises before the mind's eye of our civil community, and perhaps of some of the junior members of our own branch of the service for a month or so after they join, before the attentions of the adjutant, riding-master, and drill-sergeant have dispelled the illusion,—that this is all that is required of the cavalry soldier. This is the scene so often depicted by our popular painters of cavalry subjects. This is the brilliant and exciting episode so often described by James, Lever, and other writers of cavalry romance.

This is the popular idea of cavalry action in general, and unfortunately the popular idea is that this is all, and that any one who attempts to introduce anything like method or calculation into the affair, must be in some degree wanting in the true spirit of a cavalry soldier. This, I think is one of the greatest obstacles to improvement in our cavalry arrangements. People forget or will not remember, that the days have arrived when we must sacrifice romance to method and calculated arrangement—that dash and daring alone will no longer carry everything before them.

We who have been brought up in the hard school of cavalry training know how much it really requires to bring the cavalry soldier up to the attacking point.

One side of the picture is very brilliant and attractive; but if we turn it and look at the other, the contrast is great. Here we see the drill-sergeant working assiduously in his vocation, and the adjutant in his, the riding-master's constant care in the training of men and horses, the veterinary surgeon working in his department, and above all, the commanding officer toiling at his daily and arduous task, through evil report and good report, through trials of patience and temper to bring all up to this attacking point.

This may appear an unpardonable digression from the subject under consideration, but it leads up to the following point:—that however brilliant and overpowering the action of cavalry may be, when once brought up to the attacking point, and launched against the enemy,

it requires much time, patience, consideration and method to bring it up to this point, particularly in the present day when it has so many more difficulties to contend with than formerly. The assault of a well-organized body of cavalry in good order will carry everything before it, more particularly if preceded by the immediate action of artillery. But there is no arm of the service so ticklish to deal with as the cavalry. A comparatively small matter will produce disorder; and nothing but ruin and failure can attend the attack of a broken and disordered cavalry.

The cavalry being assembled under the protection of some accidents of the ground, it follows that, unless in exceptional cases, the exit from such ground on to the open ground will be through roads, ravines, passes, or defiles of some description. The exit must therefore be effected by means of small columns of route which shall subsequently form on the move under the protection of the artillery. The organization of these columns must therefore be simple, and free from all complication, so as to admit of their threading their way through broken, difficult, or varying ground, without disorder. The subsequent formations from such columns to a fighting order, must also be perfectly simple, free from all complication, and above all, free from that restriction commonly called the law of pivots, so as to admit of a gradual and effective formation even under fire, and the influence of excited animals and human beings, in the midst of smoke, dust, noise, and all the tumult and confusion of cavalry action.

The artillery also should work with the cavalry, according to a method, the first principles of which should be well and closely calculated, the application being simple and practical, not acting at random, but acting in concert with the cavalry—an assured course of action, as well as a point of formation under the protection of the supports, or otherwise, being pre-arranged, when their action with the attacking force becomes no longer possible.

We now come to the final question up to which we have been working all this time. How is this column organization to be arranged? how is the formation from columns of route on the move to be effected? and how is the action of the cavalry to be effectively combined with that of artillery?

I think the answer is as follows:—By the means adopted in the present day for the carrying out of all the gigantic projects of modern improvement; by the means adopted for the furtherance of railway arrangements all over the world; by those means, the employment of which, produced those interesting results exhibited at the late Paris Exhibition, where all the triumphs of mechanical skill and elaborate manufacture were displayed on scales varying from the grandest to the most minute.

What these means are, I think can be stated in a very few words.

In the first place, to bring to our assistance, in establishing our first principles that calculus or method of calculation, comparatively modern in its application, by means of which we can arrive at sufficiently accurate results within certain and defined limits, even when the elements to be dealt with are variable; that wonderful power

which is applicable to subjects in which the deviation of even the hundredth part of an inch, or the tenth part of a second may materially affect the accuracy of the calculation, and also to subjects in which an error of miles in distance, or hours in time, will not produce a sensible error.

I shall not have to go beyond the first rudiments of this mode of calculation. The very simplest form of the calculus of variables will be quite sufficient for the work we have in hand. Nor should I have to use it at all, except that the subject we have to deal with, is subject to variation. Our paces vary; in our cavalry regulations the extent of the front varies; and the same with many other points in cavalry tactics. I have not time to discuss them at present, but this variation seems to have led people to the conclusion that cavalry movements cannot be brought to a matter of calculation at all.

The second means which I should propose to employ, would be to adopt that system which has worked so well in modern times, namely, that close attention to all minute details, that complete and perfect polish and finish of all the accessory parts, which has produced such wonderful success in everything around us. We see it in all the necessaries and luxuries of life, in our wearing apparel: in the wonderful accuracy and effects of machinery; in the texture of manufactured fabrics; in the illustration of our papers and periodicals; in short everywhere and in everything; but above all in the improvements in the action of our artillery and small arms.

I shall now come to the subject I have to deal with. I have divided it into three heads:—

I. *The organization of the column.*
II. *The formation to line or fighting order from column.*
III. *The movements in fighting order supported by artillery.*

And in each of these cases I shall endeavour to show how I should propose that the application of the means just indicated, should be carried into effect.

I. *Organization of the Columns.*

1st. *Relative Position of the Front and Rear Rank in Column.*

According to the present system, the front rank and rear rank men hold the same relative position in column as in line, with the exception of column of fours (eight men abreast), in which the front rank and rear rank are in line.

I should propose that the regimental column should consist, first, of the whole of the front rank in column, followed by the rear rank in column, both in column ranks according to the frontage of the column.

By this means a certain amount of complication will be avoided; the length of the column will not be increased; and all the column movements will be simpler and more regular. Other advantages are gained by this arrangement, which I have not time to mention at present.

2nd. *Directing or Regulating Point in Column.*

The leading and regulating point in field columns should be in the centre, as in line. By this means we gain a certain amount of uniformity, and consequently of simplicity in our arrangements; for the leading and regulating point will be the same, whether in column or in line. This is also the mode of leading in column adopted by other nations, even by those who lead by a flank in line.

The column being composed of rank entire, we can introduce troop and division leaders between the column ranks in field columns as low as divisions of eight.

The centre regulating principle will also enable us to diminish the velocity on the wheeling flank, which, according to the present system, is excessive, causing unsteadiness in changes of direction in column.

Frontage of the Columns.

I should propose that the columns should consist of—

Squadrons	32	Files
Troops	16	,,
Divisions	8	,,
Fours'	4	,,
Files	2	,,
Single Files	1	,,

This is evidently a geometrical series or progression, of which the common ratio is 2.

I have put the squadrons at 32, as I think this is the smallest force which ought to be employed as an independent fighting body, which a squadron might be required to be on occasions; and because I do not think it likely that, according to present arrangements, we shall be able to bring our squadrons in the field up to a higher number. As we have adopted the movement by fours instead of threes, it is, of course, desirable that the divisions should divide by four. Therefore, if we can bring squadrons of greater strength into the field, the series would be—

Squadrons	48	Files
Troops	24	,,
Divisions	12	,,
Fours	4	,,
Files	2	,,
Single Files	1	,,

I have adopted the old denominations of files and single files, as, in the first place, a file of men has been generally taken to indicate two men, a single file one man; and as in rank entire, fours are formed *bonâ fide* of four men abreast, there is no reason for changing the old denomination.

I shall not enter here into the discussion as to the comparative advantages of fours and threes. Like many other things, there is a good deal to be said on both sides; but as fours have been adopted in our service, and approved of, I do not think there is sufficient reason to advocate a change.

It has been an old custom to divide our squadrons into troops. There may be much to be said in favour of this division, although it may not be essential, and, therefore, I should not propose a change in this matter either.

Working in rank entire, there are 16 feet from head to croup in column of divisions of eight. We can, therefore, introduce the troop and division leaders between the column ranks. According to the present system, there are only 12 feet from head to croup in column of divisions of 12.

In Colonel Baker's system, the rear rank is as formerly—at half a horse's length distance from the front rank. This gives a distance of 16 feet from head to croup in column; and as the division leader is at half a horse's length distance in front of his own division, there will be also half a horse's length distance between him and the rear rank of the division in front.

II. *Formations to Line, or Fighting Order from Column.*

Pace.—Our Cavalry Regulations tell us, that in the cavalry, the pace cannot be reduced to a matter of calculation, as in the infantry; but we are not told why the pace of the horse is not to be depended upon in the cavalry as the pace of the man is depended upon in the infantry, or why the arrangements as to pace generally, are not to be worked with the same degree of exactness and precision in one branch of the service as in the other.

As to the pace of the horse, I have had a long experience of many years in the matter. I first began to appreciate the exactness of a horse's pacing when I was a student at the Staff College at Sandhurst. In those days we used to sketch ground, as I think it is not improbable they do at the present time. At first I only used my horse when I was tired, or had some work to do which did not require any great exactness—such as filling in under features of ground, cross roads, &c., when, being surrounded by fixed points, I had no reason to fear an accumulation of error; but I soon began to find that the length of pace of the horse was more to be depended upon than I had any idea of. I then tested it upon the roads by the mile-stones, and seldom found the pacing in a mile out more than 30 or 40 yards. I could not do better than this myself, and consequently have since depended upon my horse, whenever practicable, for pacing distances.

I have surveyed a good deal of ground in India, Turkey, Asia Minor, &c., and have depended upon my horse for measuring the ground; and during those experiments, I found that the faster pace of the horse (16 miles an hour), when the horse takes about four yards in each stride, might be fully depended upon for measuring distance.

Those who have been employed in rapid sketching under difficulties, will know how valuable such an application of the horse's capacity in this respect, may be made. I have applied this mode of measuring ground to the movements of artillery combined with cavalry. I have had experiments made in this matter both in India and in this country, and several officers who were present, both of artillery and cavalry, could testify to the wonderful exactness attained by horses, even at their first trial. I did not expect or require more than an approximation—but I found the exactness to equal if not exceed the exactness of infantry pacing.

If such be the case, are we to cast this valuable assistance from us merely because the Regulations say it is unattainable? The power of measuring distances rapidly, and tolerably exactly under fire or in dust, smoke, &c., is more important now than ever, and this can be best done by holding your horse straight and counting his paces.

So much for the length of pace; as to the rate of pace, and combination of paces—although this seems to be treated as a matter of comparatively minor importance in our Regulations—it is the great power which the cavalry possess towards neutralizing or counterbalancing the preponderating effects of the artillery. The proper combination of paces gives us the power of making our formations on the move as it is called, that is, on a moving base, without affording a standing mark during the movement.

When we speak of pace or velocity, we must have some standard to measure it by. Our present standard, is miles in distance, hours in time. I should propose for a standard, seconds in time, yards in space or distance, and that the velocities or rates should be as follows:—

Walk	2	yards in	1	second.
Trot	4	,,	1	,,
Gallop	6	,,	1	,,
Gallop out	8	,,	1	,,
Fast gallop	10	,,	1	,,

The three first rates do not differ very materially from our present rates. The walk would be four miles an hour, as it is at present, the trot about eight miles an hour, the gallop about twelve.

Eleven miles an hour, if it is really ever done in the field, is very slow; in galloping past, the artillery cannot keep this pace; the traces won't draw. There appears to be no object in making the gallop so very slow. It will be seen that the standard of paces proposed, consists of an arithmetical series of five numbers, of which the extremes are two and ten, and the common difference two. There is no time to discuss all the merits of this question, but I think it will be apparent

how valuable such an arrangement might be made in the combination of paces, and, consequently, in formations on the move.

Formation en Bataille, or Fighting Order, from Field Columns.

The present mode of formation from column to line generally recognized, is by means of the oblique échelon.

I shall now say a few words as to the supposed advantages of this mode of formation, and also as to what I conceive to be the objections to this movement when applied to cavalry formations.

Oblique Échelon.

The advantages of oblique échelon with reference to the formation from column to line are stated to be as follows in the Cavalry Regulations:—

1st. The preserving a general front during the march.

2nd. Retaining the power at any moment to stop the movement, form line, and repel an attack.

As to preserving a general front during the march, the units forming the oblique échelon, all front to the direction in which they are moving, that is, upon lines at an angle of 45 degrees with the original line of covering of the column and the future line of formation. This would be so far good if they also preserved a fighting order during the movement; but, on the contrary, the leading troop or division, is the only portion of the échelon free to act offensively on the line of movement, the remainder overlap each other, and if they attempt to attack in that direction, they simply ride over each other and become a mass of inextricable confusion.

As to retaining the power at any moment of stopping the movement, wheeling into line, and repelling an attack, the only line which can be formed must be parallel to the original line of covering of the column, and at right angles with the future line of formation; and this line can only be formed, upon the supposition that the covering and distance of the échelons have been correctly preserved.

It would be reasonable to suppose, that the front formation was about to be made facing the expected point of attack; and it would hardly be reasonable to suppose, that without some extraordinary want of precaution on our part, the enemy should suddenly appear directly on our flank, and attack in a direction at right angles to the originally threatened line of attack.

It is possible that during the formation, the enemy might attack with part of his force somewhere about the angle formed by the future line of formation, and a line at right angles to it.

But for all purposes of attack in this direction, we are for the time being, helpless, in consequence of the overlapping of the units of the échelon.

I conceive the objections to the oblique échelon formation to be the following:—

1st. Defective arrangements as to covering and distance.

2nd. Necessity of clearing the column in its whole length upon issuing from a road or ravine, or when passing round the flank of formed troops.

3rd. Necessity of an open right-angled triangular space free from obstacles, of which the two sides are the line of formation and the line of covering of the column, and of which the hypothenuse represents the path traversed by the rear unit of the échelon during the formation, and this is upon the supposition that the formation is made upon a halted base—if it is made on the move, an additional clear space will be required, represented by a parallelogram of which two of the sides are each equal to the extent of front—and of which the two remaining sides are dependent upon the combination of paces employed.

4th. Movement scattered and unprotected during the formation, particularly when the formation is effected on the move.

The preservation of the covering and distance, is particularly difficult for cavalry when in this formation, especially at the fast paces.

If the covering is taken along the front or rear line of pivots, even at the walk, it is most difficult, and at the faster paces, all but impossible, to keep it; for even a slight wavering in the line of pivots, the springing forward or hanging back of a single horse, a slight loss of covering in any one of the ranks of the échelon, shuts out the view of the line of covering, and, until the view of the general line is regained, there is no guide whatever for the échelons in rear of the point where the covering was lost.

This method of covering also involves the difficulty attendant upon moving in one direction, and preserving the line of dressing in another; and requires that the post of the leader of each échelon, with reference to covering, be actually on the pivot flank of the échelon which he leads.

The position of the troop leader in our service, in front of the second file from the directing hand, renders it impossible that he can preserve the covering upon this principle; hence arises a divided responsibility, the leader being answerable for the distance, and the guides for the covering.

This produces a complication, where all ought to be simple and plain; increases the number of links in the chain of responsibility, and consequently the number of sources of error.

In the present case we not only increase the number of responsible leaders, by breaking up the squadron into two parts, but we add in addition what may be called a twisted link between the leader and the troop or body which he leads; for the troop must move and dress by the guide; the guide is responsible for the distance from the troop leader; and the troop leader is responsible for the distance from the troop in front; besides which, the guide must judge the covering for himself, without any reference in that respect to the position of the leader.

It can scarcely be denied that this arrangement is bad; for surely the leader of a body of cavalry in the field, when in presence of the enemy, should be wholly and solely responsible for the leading of the

body which he commands; all ranks should look to him for guidance and direction; and divided responsibility should be avoided as much as possible.

It is not distinctly laid down in our regulations by what method the covering is to be preserved by the guides on the inner flanks of troops, and it is only by inference that we can come to the conclusion that the guides are responsible for the covering in oblique échelons as well as in column of troops.

If the principle of covering along the oblique line of the flanks of the échelons is not followed, the only remaining method is that of covering a particular file of the échelon in front.

In this case we are liable to the error produced by the opening out and closing of the ranks, as well as by the line of covering being broken instead of continuous. Altogether the system appears too complicated to be depended upon for rough work and rapid movements, and if the covering and distance cannot be preserved at all paces, and under all circumstances, we lose the great advantage supposed to belong to the oblique échelon formation, namely, the power at any moment to stop the movement and wheel into line.

The formation from column to line is laid down in our Cavalry Regulations for the regimental column only. It may therefore be intended, that in brigade movements each regiment upon coming on to the open ground should form independently: and therefore it would be only necessary to extricate the rear of the first regimental column before commencing a formation to fighting order. But this would mend the matter very little, for another necessity in the system of oblique échelon formations is, that the whole line of covering of the column from front to rear must be placed at right angles with the future line of formation, or, at least, at an angle not differing very materially from a right angle, as otherwise the whole arrangement of the system dependent upon all the units of the échelon except the first moving upon parallel lines at an angle of 45° with the line of formation, will be lost. Therefore before the commencement of the line formation in the last regimental unit in the column, the general base of formation must have advanced a distance equal to the entire length of the brigade column, or nearly so. This distance will be greatly increased if the formation is made on a moving base.

In all formations to line from column by means of the oblique échelon, the line of formation and the line of column form two sides of a parallelogram, upon the diagonal of which, the last unit of the échelon moves to a point opposite to its place in line.

The triangular space thus inclosed, is during the formation covered by troops or divisions (according to the frontage of the column) all moving on parallel lines to their separate points of formation. If there should be any obstacle, natural or artificial, within this space, it must of necessity break the line of covering of the échelon. And it has been already shown that this line is most difficult to retain, and almost impossible to regain, in rapid movement.

In the French service, the difficulty just mentioned, is got over by breaking up the general column into squadron-columns of divisions,

which move upon diagonal lines to sixty paces in rear of their points of formation in line. Each column then wheels so as to place the front of the column parallel to the future alignement; and the squadron formation to line is completed by the oblique échelon movement within the sixty paces.

If the formation is effected upon a moving base, a clear space, without impediments, represented by a parallelogram of which one side equals the line of formation, and of which the other is dependent upon the combination of paces employed, is necessary for the reasons already specified. During the process of formation, all the units of the échelon remain scattered about the field—totally unprotected and uncovered by the portion of the force already in fighting order—and if the formation is made upon a moving base, this helpless state of transition is sensibly prolonged.

From the moment that the last unit of the oblique échelon turns from the oblique to perpendicular line of movement with reference to the proposed line of formation, the whole breadth of the line is exposed as a mark to the aim of the enemy's artillery. And this without the efficiency and advantage of a line formation.

If the formation be made on the move, the dangerous and transition position of all the unformed portion of the force will be more or less prolonged.

Formation from Column to Line.—I should propose that the formation to line from column should be made indifferently to the right hand or to the left, or, as Colonel Baker expresses it, "a column should wheel "to either flank, or form to the left or right of its head."

I should propose that this inversion (as it is commonly called) or change of position of the units in line, or whatever it is proper to call it, should not extend lower than the column of fours.

Supposing a regiment to consist of four squadrons of thirty-two files, each squadron of four divisions of eight, and two troops of sixteen, the effects of the arrangements just proposed would be the following:—

The flank squadrons respectively would sometimes find themselves on the right flank of the regiment, and sometimes on the left. The centre squadrons would sometimes find themselves on the right of the centre of the regiment, and sometimes on the left.

The same would hold good with respect to divisions with reference to squadrons, and with respect to fours with reference to troops. As to the troops they would find themselves, one time on the right of the centre of the squadron, and another time on the left. Surely there is nothing in this to confuse the intellects of squadron troop or division leaders; it is not half so puzzling as acquiring and recollecting the rules relating to inverted movements in our cavalry regulations.

It seems now to be generally conceded, that as far down as columns of divisions, there is no insuperable difficulty in the matter; but if we speak of what is called inversion by fours, we are met by a look of distrust and a feeling of intolerance of so great a change; but after all, where is the difficulty in this case more than in the others? The right flank man of fours, remains the right flank man still: the left flank

man, the left flank man still; the right centre, the right centre, and the left centre, the left centre man still; and what possible difference can it make to any of these four individuals when they are ordered to wheel right or left, or about by fours, whether they happen at the time to be on the right, or on the left of their squadron troop or division? Surely we may trust the intelligence of our cavalry soldiers so far. We give them books, periodicals, comfortable rooms, easy chairs, writing paper, and in all respects treat them as intelligent beings, and I think we may give them credit for knowing in the field this small matter, particularly when we relieve their minds from other complications.

This last point gained, the great power we should acquire in facility of formation from column of route on the move, must be evident, and when it is recollected that this is one of the great desiderata of the present day, this facility of forming on the move from columns of route rapidly and effectively, I think it will be admitted that it is worth sacrificing a certain amount of antiquated prejudice to attain it.

Formation from Columns of Route.

The principles of the proposed formation are—

1st. That each unit of the formation, and consequently each rank of the column, should pass at once by a single wheel, made according to the principles of wheeling already specified, from column to direct échelon, and then to line.

2ndly. That the portion of the force still in column should be protected from the view and action of the enemy, by the portion already formed in line, and consequently in fighting order.

3rdly. That the formation should be made indifferently to either hand, on a moving base.

The velocity of this moving base to be completely under the control of the Commandant of the cavalry force, as also the corresponding velocity of the remainder of the column, the slackening or acceleration of which, with reference to that of the moving base, evidently modifying the time and space required for the formation.

4thly. That the distance to be passed over during the advance by the base of formation from the moment that the line formation is commenced to the moment that it is completed, shall depend upon the angle of inclination taken by the head of the column on issuing from the closed ground upon the open. This also will be completely under the control of the Commandant of the cavalry, and it must be plain how very important this latter would be, for there may be cases when, with reference to the position and movements of the enemy, a quick formation to a fighting order may be indispensable, while the base of formation passes over a comparatively short distance. On the other hand, there may be cases when it may be desirable to pass over a considerable distance at a rapid pace, exposing during the transit as small a front as possible to the enemy's artillery. It will be evident that in such a case a very rapid line formation would not be desirable, it would be only necessary that the formation to fight-

ing order should be completed upon arriving within attacking distance, and not before. There may also be an intermediate case between the two already described, when a moderate rapidity in the line formation with reference to the distance advanced by the base of formation, may be the most desirable.

III. *Movements en Bataille, or Fighting Order in presence of the Enemy.*

1. *Separation of the Ranks.*—According to the present regulation, the rear rank should be at a distance of one horse's length from the front rank; but we cannot expect this distance to be preserved in the hurry and excitement of action. The tendency of the rear rank horses when excited, is to press upon, or between, the horses of the front ranks.

I think that few will now contend that any additional impetus is given in the charge to the front rank by the actual pressure of the rear rank; in general, the tendency of a horse, when pressed upon by another, is to hang back or kick. If the rear rank should be held in hand as a support at some short distance from the front rank, a shot producing a casualty in the front rank may pass harmlessly over the heads of the support; whereas, if the ranks are close together, the same shot may produce a casualty in both. In any case, if a front rank man and his horse go down, it is ten to one that his coverer goes over him.

With the arrangement proposed, the squadron, or any other body of cavalry, will form from column of route, and show a fighting front in one half the time they could do so if working according to the present system. The assault could then be delivered at once, and in the meantime a really effective support would be steadily formed in the rear. By this arrangement the front rank squadron can be equalised, and kept up to a certain strength—say 32 file; for as the rear rank is intended to act as an independent support, it is not absolutely necessary that each front rank man should have his coverer behind him, or that the front rank and supporting rear rank squadrons should be of exactly the same strength; files may therefore be taken from the rear rank or support, to fill up vacancies produced by casualties in the front rank, without interfering with the exactness of the future movements in line. Skirmishers may be sent to the front from the support, without altering the intervals or extent of front of the front rank squadrons. The rear rank squadrons may also be used for flank attacks, or to protect the flanks of the front rank line; and if the action of the artillery should be combined with the advance of the attacking line to the last moment previous to the assault, the rear rank, or support, or a certain portion of it, will be in the proper place to support the guns, and their escort, when the first line has passed forward to the charge.

I find that there is not sufficient time now to enter into further details in this important matter, and shall therefore confine myself to bringing before you the opinions on the subject of high military authorities of former times, contained in the following extracts:—

Extract from a letter from F. M. The Duke of Wellington, K.G.

"*Strathfieldsaye, 20th Nov.*, 1833.

"Cavalry is essentially an offensive arm, whose use depends upon its activity, combined with its steadiness and good order.

"I think that the second rank of cavalry at the usual distance of close order, does not increase the activity of the cavalry. The rear rank of the cavalry does not strengthen the front rank, as the centre and rear ranks do the front rank of the infantry. The rear rank of the cavalry can augment the activity, or even the means of attack of the front rank only by a movement of disorder.

"If the front rank should fail, and it should be necessary to retire, the second or rear rank is too close to be able to sustain the attack or to restore order. The second rank must be involved in the defeat and confusion, and the whole must depend upon some other body, whether of cavalry or infantry, to receive and protect the fugitives.

"I have already said that the rear rank can only augment the means of the first rank by a movement of disorder.

"This is peculiarly the case if the attack should be successful. In all these cases the second rank, at a distance sufficiently great to avoid being involved in the confusion of the attack of the front rank, whether successful or otherwise, could aid in the attack, or, if necessary, cover the retreat of the attacking party, and thus augment the steadiness and good order of the cavalry as a body; while, by the absence of all impediments from the closeness of the rear rank, the activity of the front rank would be increased.

"It cannot be denied that, till required for the actual attack, the less cavalry is exposed the better. My notion of the distance of the lines of cavalry was as much as a cavalry horse could gallop in a minute; the second line should pull up at a walk when the first charges; the third and other lines in columns should deploy, or be used according to circumstances.

"I conceive that the one-rank system would require a change, not only in the discipline, but in the organization of the cavalry. If I am not mistaken, it would render the use of cavalry in an Army much more general than it is at present.

"WELLINGTON."

Extract from a Letter to General Bacon, from General Sir Hussey Vivian, G.C.B.

"As to the rank entire system, I am by no means certain that it would not always be a good thing, if on advancing to an attack, or standing in line, the rear ranks were to form a reserve at the distance, say of 80 or 100 yards; when so circumstanced they would be much better able to follow up an advantage gained by, or to repel a successful attack of, the enemy on the first rank. The fact is, that the second rank is but of little use but to fall over the first.

"R. HUSSEY VIVIAN."

Extract from a Letter to General Bacon, from Lord William Russell.

"Anything that proves the efficiency of the single-rank system is interesting to me; and it certainly was thoroughly proved on the 16th October, 1833, when your force of cavalry imposed on more than treble your numbers; this quite destroys the argument that a single rank 'looks so weak,' and 'invites the enemy to charge.'

Your adversaries were not to be tempted on the 16th. Keep notes of all the occurrences; we will one day put them in print.

"I am delighted to find that Vivian, (Sir Hussey) looked with a more favourable eye on the system. Depend upon it they will all come round. He wants to get off on the *mezzo termine* of leaving the rear rank behind. This I entirely disapprove, because the rear rank so left would have no one to command it, and cavalry depends entirely on its officers.

"There is no doubt that, if cavalry is to act in one rank, a different organization is necessary. You must turn your mind to this, as the end of the war brings to your aid the practical reflections you can make now. The Duke of Wellington is in our favour, but the prejudices of the cavalry officers are difficult to be overcome.

"WILLIAM RUSSELL."

Advance or Retreat in Line protected by Artillery.

According to the present system, the advance or retreat of a body of troops, is generally preceded by the fire of artillery directed against the troops and artillery of the enemy. But it would evidently be very advantageous, if the action of the artillery should also continue during the movement. This can only be effected by the artillery taking up consecutive positions, the distances between such positions being so regulated that the following conditions may be fulfilled:—

1st. That the coming into action or limbering up of the artillery in the advanced position, shall be protected by the fire of artillery in the rear position.

2nd. That the movement of the troops should be so arranged, that in the advance, the fire of the artillery in action shall not be masked before this purpose is effected, and that in retiring, the artillery in the rear position shall not be unmasked till the battery is in action ready to protect the limbering up of the advanced battery.

If we take the simplest case, and suppose two bodies of artillery (say two batteries) working with a body of troops, either cavalry or infantry, one on each flank, it will be evident that while the body of troops passes over the distance between the consecutive positions of the artillery, during which time one battery remains in action, the other battery must limber up, pass over double that distance, and come into action.

Allowing thirty seconds for coming into action, and the same time for limbering up, also taking the velocity of the artillery at the rate of eight yards in a second, or about sixteen miles an hour, the distance between the consecutive positions of the artillery will be found to be equal to 240 yards.

In trials both in this country and in India, I have found that the time allowed (thirty seconds) for limbering up and for coming into action was more than sufficient; but it is well not to hurry the movement, and sufficient time should be allowed for laying the guns.

The pace of the artillery also is not excessive, it is simply a fast gallop, and if even this rate of pace should be temporarily retarded by rough ground or otherwise, it would be only necessary that the cavalry should temporarily check their pace also till the obstacle was overcome, and the artillery again resume the original pace. This is a compensating power which does not exist in any mechanical con-

trivance or arrangement, inasmuch as it depends upon the human will and intelligence.

If either the cavalry or artillery are momentarily thrown out of the usual rate of pace by any circumstance, the Commandant of either arm, knowing the conditions to be fulfilled, and which have been already stated, can accommodate his own movements to this temporary change by either accelerating or retarding the pace of the arm which he commands.

I have no doubt that before long, some mode of expediting the process of coming into action or limbering up will be discovered; as also some improvement in the construction of artillery limbers and carriages, by lowering the centre of gravity or otherwise, which will enable them to move at even a greater velocity than at present.

Improvements in either or both of the points just stated would enable us to shorten the distance between the successive positions of the artillery, and consequently to lessen the distance at any moment between the cavalry and the artillery.

On Monday evening, March 2nd, Major W. H. Ross, R.A.,* will bring before you in this place his projects with reference to "Field Artillery on the Connected System," and I think it will be found that this matter is intimately connected with the points just treated of. As the matter stands at present, the artillery must be strongly guarded by a cavalry escort.

The two flank squadrons of the line might move on the outer flanks of the artillery, and when the line of cavalry passes the last position of the artillery, join the cavalry in the attack, protecting the flanks or otherwise as required, the artillery waiting for or falling back upon the support. In any case, the whole line of cavalry would reach the artillery in about twenty seconds, even upon the supposition that they were threatened by a close attack at the first moment of taking up their position.

The escort of cavalry will be sufficient to protect them from any sudden or partial attack, and the smallest exercise of judgment on the part of the Commandant of the attacking force, will prevent the possibility of their being exposed to anything like a general attack unprotected during the advance.

As has been already stated, the whole body of the cavalry could, if necessary, be up with the artillery in about twenty seconds, and this is upon the supposition that the cavalry are at the maximum distance from the artillery; but every moment that the latter remains in position, the cavalry are approaching closer and closer.

So long as the artillery position is closer to our own line of cavalry than to the force of the enemy, it is evident that before the latter can gain such position the cavalry will have reached the artillery and passed on to the attack, when the artillery can form with the supports, or take any course which may have been pre-arranged. Besides which, the first positions are taken up by the artillery upon the supposition

* See Journal of the Royal United Service Institution, vol. xii, page 72.—Ed.

that the enemy, although within range, are comparatively at a distance. In taking up the last position, the speed of the artillery may be increased; and as the distance between the attacking forces diminishes, laying the guns, &c., will not be of so much importance, and therefore the time allowed for coming into action may be reduced. The distance between the alternate positions of the artillery, and consequently the maximum distance of the artillery from the cavalry, varies directly with the time occupied in coming into action, and inversely with the velocity of the artillery; it follows, therefore, that in taking up the last position immediately preceding the assault, the distance between the cavalry and artillery, may be reduced.

In this case, as in all others, we must trust to the judgment and intelligence of the Officers in command of the forces employed, to modify their combined action according to circumstance. There may be cases in which the artillery might be compromised if more than two positions were taken up, and it might even be found inexpedient to take up more than one.

This action of the horse artillery during the advance or retreat of the cavalry does not of course preclude the adoption of all the old established arrangements with respect to the artillery action previous to or during the advance from fixed positions.

It must be recollected that even if the artillery are for a few seconds in a position in advance of the cavalry, the whole arrangement is effected according to a well considered method. The artillery are well protected, and in a few seconds the whole force of the first line of the cavalry would be up with them. It is unnecessary to enlarge upon the great power gained by carrying the action of the artillery with the attacking force of cavalry up to the last moment preceding the charge; to gain this great power, we must risk something. If we only recall to our minds the wonderful feats performed by this splendid arm of our service, the Horse Artillery, and the risks run without the protection and methodical arrangements indicated above, I think we shall come to the conclusion, that we need not fear their being compromised, because they are a hundred yards or so in front of the cavalry, when the enemy are at such a distance as to preclude the possibility of an attack before support can reach them. To gain anything in the present day, we must trust to well-calculated arrangements to obviate risk. This is done in railway arrangements all over the world; otherwise, railway traffic would be next to useless; without method and arrangement collision and accident would be imminent; but with a well-considered and methodical arrangement, the risk is reduced to a minimum. It will be evident that the formation to line on the move from column, or any other movement or formation involving a continuous advance or retreat of the base of formation, can be protected by the action of the artillery just described.

In all these cases, although the principles are closely and carefully calculated, it would be found (were there time to describe it) that the practical application was perfectly simple and suited for working in the field under all circumstances.

In a short lecture, like the present, it is impossible to enter into the

details involved in so wide a subject as that under consideration; but, I trust I have succeeded in giving you a general idea of the modifications in our present systems which I should suggest, in order to bring into action the means which I started by proposing as applicable to cavalry arrangements, and which have produced such wonderful successes in other matters to which they have been applied in modern times, namely, a close calculation of first principles, and an attentive consideration of all the minute details.

I find that I have already exceeded, by more than twenty minutes, the time generally allowed for lectures in this theatre, and, thanking you for your kind attention, shall now conclude.

The CHAIRMAN.—Gentlemen, I have to ask you for a vote of thanks to General Smith, for the able lecture we have had this day.

Evening Meeting.

Monday, April 20th, 1868.

MAJOR-GENERAL J. T. BOILEAU, R.E., F.R.S., in the Chair.

NAMES of MEMBERS who joined the Institution between the 30th March and the 20th April, 1868.

LIFE.

Saunders, A. W. O., Captain, 21st R.N.B. Fusiliers. 9*l.*
Logan, Alfred, Lieut. Roy. Art. 9*l.*

ANNUAL.

Weguelin, J. C. R., Capt. 2nd Royal Surrey Mil. 1*l.*
Conybeare, Frederick, Lt.-Col. R.A. 1*l.*
Garforth, E. St. John, Comr. R.N. 1*l.*
Stafford, P. P. Leslie, Major M.S. Corps.
Addington, Hon. C. J., Major 38th Regt. 1*l.*
Varlo, Henry, Capt. h.-p. R.M.L.I.
Burgess, C. J., Capt. late Adjt. 9th Adm. Batt. Lancashire R.V. 1*l.*
Adams, Thos., Capt. late 39th Regt. 1*l.*
White, H. G., Capt. 1st Royals. 1*l.*

MUZZLE-PIVOTING GUN-CARRIAGE; LEVER, FULCRUM, AND INCLINE-PLANE PRINCIPLE.

By Captain T. B. HEATHORN, h.-p. R.A.

THE subject which I have the honour of again bringing before you, is one that I resume from the discussion, after Colonel Shaw's able and interesting lecture on his muzzle-pivoting gun-carriage, which took place here on the 5th June, 1865.

It may be remembered that I then first introduced to this Institution the lever, fulcrum, and incline-plane principle for muzzle-pivoting gun-carriages, producing drawings, and giving a short statement of my construction, which the Committee were kind enough to publish in No. 37, Vol. IX of the Society's Journal.

Although in those diagrams a counterpoise was shown in order to assist in lifting the weight of the gun, in my later constructions I have dispensed with it; not abandoned it as useless, by any means, for I still consider a counterpoise as a useful and effective adjunct for many circumstances, but I purposely omitted for the following reasons:—

1stly. Because sufficient was accomplished without it.

2ndly. Because, if required, it could always be added.

3rdly. Because it cost more.

4thly. Because the Ordnance Select Committee, who at that time I fancied were favourable to my invention, did not like the counterpoise as increasing the weight of the carriage, without commensurate advantage.

It is pretty generally felt here and abroad, that muzzle-pivoting gun-carriages will be used in the future to work guns through minimum embrasures, the advantages of which I will endeavour to set before you as follows:—

1st. Increased protection to guns and gunners; and as guns are expensive, and men scarce, both may be considered worth protecting. In a direct ratio to the size and power of a gun is the length of time between its discharges. Its powerful blows, though hard, are slow; and to the gunners behind a large embrasure, the annoyance from the enemy's riflemen would be disastrous.

2nd. A gun need not project so far through a small embrasure as through a large one to clear the port of back flash; it is consequently less likely to be struck by an enemy's shot.

3rd. A gun standing clearer back from its shield has room for a higher angle of traverse.

4th. The sill of an embrasure will be about 1½ feet higher than that of an ordinary port on the same "terre-plein," or deck—a great naval consideration.

5th. In every position of elevation, a muzzle-pivoting gun and carriage are considerably protected, being below the sill of the embrasure.

6th. Whatever angle of elevation or depression the gun may be at, the muzzle remaining in the same position in space, greatly facilitates the serving of muzzle-loading ordnance, and consequently simplifies the construction and arrangement of such necessary mechanical contrivances as are used to deliver charge and projectile to the hands of the loader.

7th and lastly. A small embrasure gives a stronger shield.

For ordinary parapet and broadside purposes, a minimum embrasure does not so much interfere with pointing as may be at first supposed, although a small aperture necessarily gives a small field of observation, but the area is not so much lessened when the muzzle-pivoted gun is at either a high angle of elevation or depression, as in an ordinary port with a piece of ordnance mounted upon an ordinary trunnion pivoting gun-carriage. There, in elevation, the bulk of the gun crosses the field of sight in the embrasure, and prevents the captain of the piece from laying it on the desired object.

A series of careful experiments in this matter would bring forth curious and interesting information, and would be as novel as inexpensive.

The only one disadvantage, therefore, of using small embrasures, is the necessary adoption of muzzle-pivoting gun-carriages; inconvenient, I will allow, in having to lift so much more weight to move the gun through its vertical arc, but more than counter-balanced by the solid advantages of the strength and protection afforded by the minimum port.

Muzzle-pivoting gun-carriages, or rather gun-carriages so constructed as to pivot the piece at any required or pre-determined optional point in its lateral axis, may be classed under the three following heads:—

Fig.

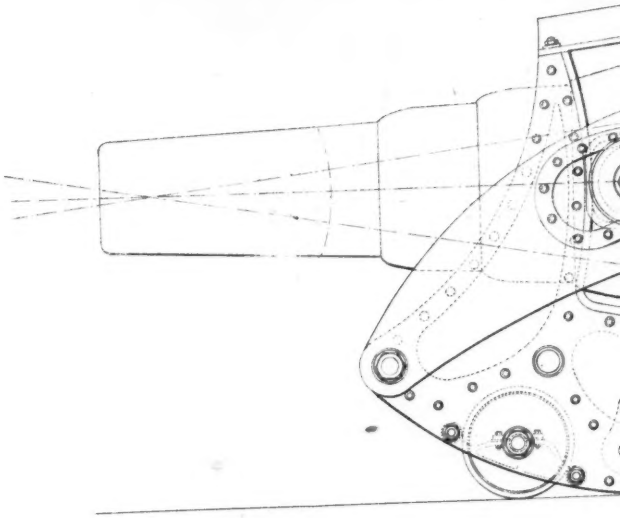


Fig. 3.

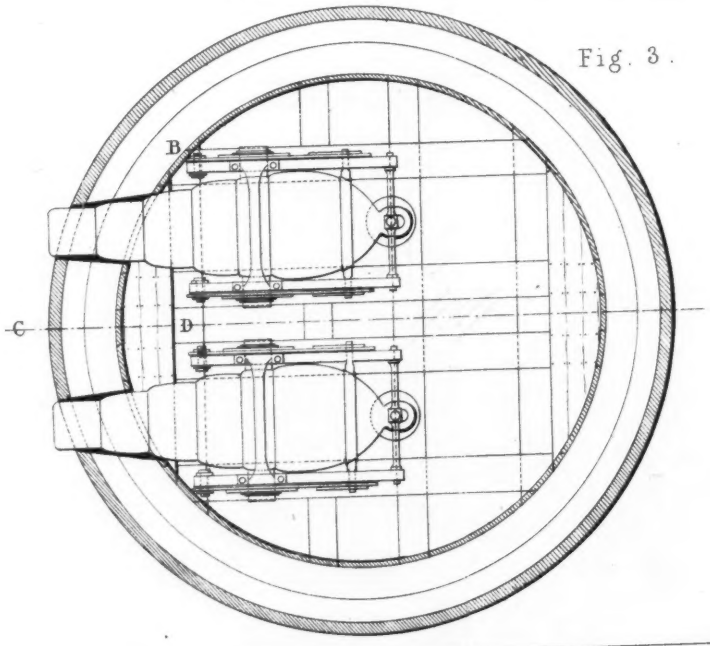


Fig. 1.

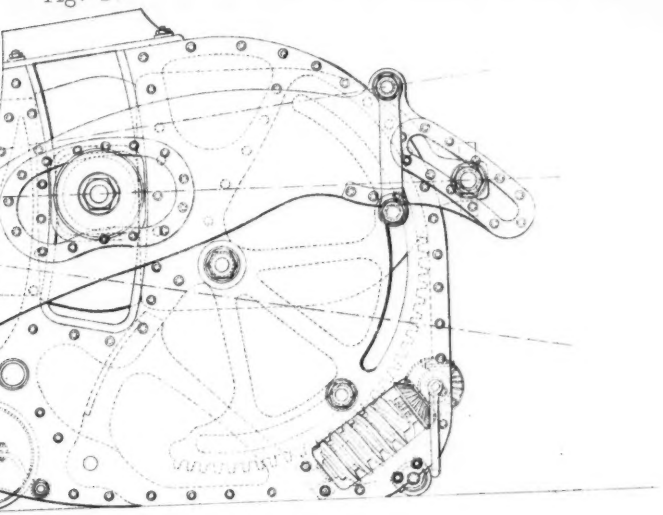
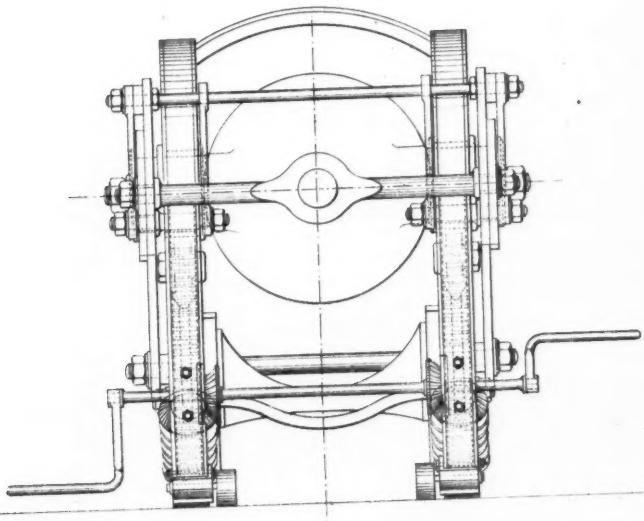


Fig. 2.



J. Jobbins.

Those that use an absolute support with the gun, to cause it to pivot on a point.	Mr. Mallet's first. Captain Blakeley's. Captain Scott's.
Those whose pivot is imaginary in space.	Colonel Shaw's. Gruson's. Lieut.-Col. Inglis's. The present Arsenal carriage. The Austrian carriage.
Those that use an imaginary pivot, but whose pivoting gear is wholly free from, and independent of, the power applied for motion.	Mr. Mallet's last. My own.

Upon the last-mentioned construction I will continue.

Early in 1865 I was impressed by the fact that the facilities for working heavy guns did not keep pace either with their size, or with the anticipation of the results to be achieved by them. Proper schemes for working appliances were undetermined, and it appeared to me to be such a new field of professional interest that I resolved to study the subject—with no particular benefit to myself, as it has turned out, but with a good deal of interest at the time, and ambition for results.

Amongst other things, I constructed the carriage before you, on the following resolutions :—

To use a lever, fulcrum, and incline-plane principle, to lift the weight of my gun, and also create a pivoting motion on an optional point.

To take the shock of recoil always at a right angle with the force of the recoil, the strongest part of the gun meeting the strongest part of the carriage.

As much as possible to avoid cog-wheel motion.

To make the muzzle-pivoting gear wholly independent of the application of power, so that derangement of the one might not interfere with the action of the other.

So to construct my carriage that for constant discharges at high angles, it could serve as a good mortar bed. This is done by scotching up the trunnions in the slot of the carriage readily and efficiently with a number of handspikes, balks of timber, or simply adjusted "quoins" made for the purpose, and, if possible, to make my carriage serve both purposes of muzzle- and trunnion-pivoting, the latter in case of derangement to the muzzle-pivoting gearing.

In March, 1866, I forwarded a model illustrating the principle of my invention to the War Office; but I am sorry to say that then, as now, in a general sort of way it was rejected and disapproved of, as inapplicable to the service.

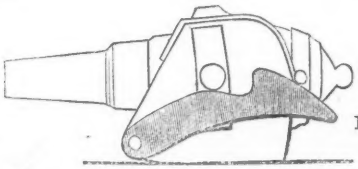
Soon afterwards Mr. Wells, an engineer, joined me in the matter, and together we took out a patent for the principle and construction of what is here before you (see Plate viii, figs. 1 and 2), and may be thus described.

Two ordinary gun-carriage cheeks sufficiently high to hold the gun-

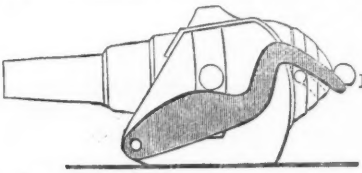
trunnions in every position of elevation and depression, bound strongly above by a massive cap-square, and equally firmly together at the base, embrace between them the gun they support. These cheeks are made of iron frames plated, or of wood covered with steel or iron plates, through bolted.

The gun-trunnions are caused to rise and fall in slots in the gun-carriage by levers fixed on either side, having for their fulcrum a common bolt. These levers may be placed either inside or outside the carriage cheeks; this was specified on my first introduction of this subject. In all these drawings I have placed them outside preferentially, because I consider their extra liability to injury in that position overbalanced by the greater facility of getting to them, in case of accident or other derangement. Moreover, the shoulders of the trunnions coming in closer contact with the slots in the carriage, take the shock of recoil better, do away with leverage, and give greater stability. But beyond this, there is no reason why, still using my system of levers and cams, the whole machine should not be boxed up, giving a perfectly flat side with no projections or working parts exposed in any way. The slots in the gun-carriage are the arcs of circles with the centre of the muzzle of the gun (or the required pivot) as centre; and the distance of same to centre of trunnion as centre radius. In each of these levers are two cams or slots—slots being preferable to cams merely because they strengthen construction, and tend to provide against disturbance by vibration; one pair of these cams or slots, act upon the trunnions causing them on the application of power to rise and fall as required; the other pair acting on a cross bar, adjust the proportional motion of the breech of the gun in excess of the trunnions, and produce muzzle-pivoting.

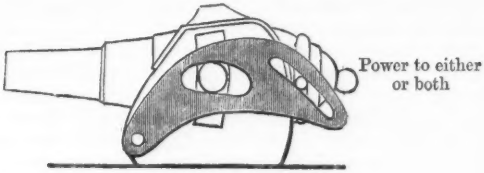
This is the principle of the pivoting gearing, and is always independent of the applied power, which may be from above to lift, from below to raise, by hydraulic ram, screw, pulley, steam power, or any other mechanical motion.



Form of lever necessary, when power is applied to levers.



Form of lever necessary, when power is applied to gun.



Form with slots, adaptable to both cases.

That the round surface of the trunnion, which at the time of the recoil strikes the slot in the gun-carriage at right angles to the force, may not cause a dent, but distribute its blow over a large surface, brass blocks to fit the slots are provided, in which the trunnions ride.

For naval carriages, I also propose to make use of the top of the cap-square, as a place to fix a strong eye or ring, to lash the gun-carriage steady to the upper deck in a sea way.

Further details of construction would here be out of place and uninteresting, I will therefore go no farther into them beyond stating, that the cams or slots in the levers are related to each other in such a way that the curve of the trunnion slot is always as nearly as possible at right angles to the vertical diameter of the trunnion, and the rear slot at as high an angle with the vertical diameter of the cross bar as circumstances will permit.

Although the plans I have here may convince you that this principle of muzzle-pivoting is applicable in many ways, I have still others showing various dispositions of levers and application of powers.

Early in 1866, I had the good fortune to be introduced to Admiral Halsted; he liked my invention, thought it applicable to the service, and induced me by his energetic example to persevere. Through his kindness and estimation of my system, I was enabled to show it in his "Model Turret Fleet of the Future," exhibited in the "Exposition Universelle," at Paris, last year. This was a great opportunity. International public opinion is a grand and fair criticism. I jumped at the chance of obtaining it.

Numerous artillerists of various nationalities, naval and military, were good enough to inspect my models, and by their favourable report recompensed me for my trouble. They gave me full credit for the originality of the idea, and the simplicity of construction; this credit I intend to hold on to as long as possible, and to it I think the fact of my introducing my plans to this Institution as early as June, 1865, entitles me.

Admiral Halsted's models will be exhibited at the School of Naval Architecture in the Kensington Museum very shortly,* and I feel quite absolved for the liberty I take in asking you to go and see my system there, by the pleasure I suggest to you, and which you will certainly receive, in inspecting his turret ships. In his broadside armament, all

* These models are now to be seen at South Kensington.—ED.

the guns have a lateral traverse of 90°, 45″ each way, which is only obtained by muzzle-pivoting.

In the spring of 1867 Mr. Wells and I were ordered by the Admiralty to furnish plans for a carriage for experimental purposes. It, however, was never constructed, and I was not treated well, for later I was informed that a somewhat similar plan was in the course of construction in the Arsenal for experimental purposes, and that no further steps regarding my carriage could be taken till the results of that trial were known.

"The Engineer" of this day, exhibits drawings of, and describes the latest carriage made in the Arsenal on the muzzle-pivoting, or rather approximate, muzzle-pivoting principle. My lever and fulcrum principle is adopted, and also the position of my fulcrum bolt. Muzzle-pivoting, however, is sacrificed for the always desirable object, of using lower power, the framers of the carriage contenting themselves with an approximation to it, and they are content to get a very limited vertical arc by dropping the muzzle, as they lift the body of the gun through space. But this is not a principle capable of extended development, for if any attempt is made to increase the vertical arc to what will be absolutely necessary, and give the gun a few more degrees of elevation and depression, the proportionally increasing passage of the guns "wabbling," muzzle will immediately demand a large embrasure. Both advantages of trunnion and muzzle-pivoting carriages are thus missed without participation in the advantages of either: and preferentially receiving the shock of recoil on the fulcrum-bolt and cogs, instead of allowing the trunnions to communicate it immediately to the body of the carriage, cannot be right. I very much object to, and disapprove of this construction as a very retrograde march, and a bad copy of my own.

I rather think that my carriage suffered from the following circumstances: viz., that I was instructed that all the running in and out gear, compressors, &c., in fact all accessories beyond the muzzle-pivoting motion were to be carried out by Captain Scott, R.N., consequently I furnished no detail for these matters; I was told to arrange for 7° depression and 10° elevation, and did so. Strange to say, on enquiry I ascertained, that the trial of my carriage had been objected to, chiefly on the grounds that it had no compressors, no running in and out gear, no buffers for recoil, and only went through a vertical arc of 17°. This was a very unfortunate circumstance for me, and I mention it because it has materially retarded the development of my plans and thrown me in the background, inasmuch as my statement that the English Admiralty were going to construct and experiment, prevented others from moving further in the matter until results were arrived at, and I have just received, curiously enough, a letter from Paris, wanting to know when the promised experiment was coming off, as much was pending on its success.

As you will not fail to notice, I commit myself to no particular system of running in and out gear, nor of compressor nor any other adjunct, buffers included, but I shall be happy to furnish muzzle-pivoting carriages to all who want them on this system, with simple

and effective gearing for compression, handy running in and out gearing, and buffers *ad libitum*.

This little model, my last construction, made for the French Exhibition, very well illustrates my plans. Since its return from France it has been deposited in this Institution. It has had a very great deal of handling, but has never been hurt by work. Its principle is exactly the same as shown in diagram No. 7.

Description of Diagrams.

No. 1 represents a 12-ton gun, muzzle-pivoted, side and end elevation with a vertical arc of 15°, viz., 10 elevation and 5 depression, forwarded to the Ordnance Select Committee early in 1866, it is worked by two vertical fixed screws assimilated in their action by worm-wheels on a common spindle acting on cog-wheels at the base of each. These screws cause the cross bar through the cascable and the rear slots in the levers to rise and fall as desired.

No. 2 represents the same gun, with the same levers, going through the same passage as No. 1, but with a different application of power; this was forwarded along with No. 1.

A powerful worm-wheel on either side works into a toothed sector, with A as centre; at that end which gives motion to the cross-bar and causes it to rise, an eccentric is provided, to allow for the action of the two constricting radii, C A and A B. Here the cross-bar does not go through the cascable, but underneath it, to leave it free for Mr. Whitworth's rear vent, of which I think a great deal, and which will be adopted, in all probability, some day abroad, if not at home.

No. 3 and No. 3a (see Plate viii, figs. 1 and 2) show side and rear elevations of the carriage, designed for the Admiralty at their request about this time last year, by myself and Mr. Wells, for a 12-ton gun, Government pattern. The cheeks are strong iron frames, iron-plated on either side. It is on the toothed-sector and worm-wheel elevating principle, the same as No. 2, but the eccentric is simplified by parallel motion and the levers connected together by a cross-bar.

Its vertical passage is 7° depression and 10° elevation, and it is also applicable for using Whitworth's rear vent.

It is calculated that four men will elevate it at the rate of 15° a minute.

Although the handles for working it appear low, they are not so in reality, for when we come to consider the thickness of the slide for broadside guns, or corresponding baulks in turret arming, it will be found that there is plenty of room, and the handles are in comfortable working position.

In both cogged-sectors, five teeth bite the worm-wheel at the same time, and thus the evils of cog-wheel motion are modified.

The bolt head near the worm-wheel shows a through fastening, serving both to bind the cheeks of the gun-carriage together, and to guide and keep the toothed-sector to its work.

No. 4 shows a plan and elevation of a carriage giving 10° depression

and 15° elevation, to one of Mr. Whitworth's 70-pounders. This is to be seen in model, in Admiral Halsted's combined Turret and Broadside System, shortly to be placed in the School of Naval Architecture, South Kensington.

This carriage is constructed of wood, steel-plated, the whole mass bolted together, which for cheapness and strength is considered very good. The power is a fixed vertical screw, worked much as No. 1 is worked.

The levers are shorter than those of the others, and the cross-bar is superseded by a pair of light trunnions on a belt.

No. 5 diagram shows the advantages of muzzle-pivoted guns, in command and protection over the usual trunnion-pivoting system, the amount of freeboard obtained, and the difference in the size of the necessary port.

The section represents Admiral Halsted's combined turret and broadside system.

No. 6 is a drawing of a gun-carriage, giving to a 600-pounder four degrees of depression and ten of elevation, designed for Captain Cowper Coles, C.B., September, 1866.

Like No. 4, it has short levers and a fixed vertical screw.

The fixed vertical screw is, I find, objected to by many, but this objection I do not participate in; the cascables of all guns mounted with this power, are slotted so that little or no vibration can be communicated to the screw; and as the trunnion-boxes in which the trunnions ride, are in close contact with the carriage, and communicate the shock at once to the carriage, I do not see what the screw has to fear. I tried the experiment of firing a little model I have in Paris, with a considerable charge, in fact, as much as it could hold; and though I bent one of the trunnions (which were rather too slight in consequence of having been turned down to fit friction-wheels upon), and smashed the table, I did not harm the screw. If any one will fire an ordinary musket with about three charges, he will find that the somewhat severe shock of recoil comes directly against his right shoulder, and may knock him down, but his left arm is not interfered with; the lever, in fact, of my carriage.

No. 7 shows almost the same plan as this model, with an ascending and descending screw. The box through which it descends, forms the centre of a large bevelled wheel supported underneath by a cradle working on trunnions, through the centres of which run the spindles bearing the small bevelled wheels communicating power.

I bring to your notice this plan of a pair of guns in an ordinary "Captain Cowper Coles turret" (Plate viii, fig. 3) to show as clearly as possible what the requirements of a muzzle-pivoting gun-carriage really are, for turret purposes. First of all the chase of the gun must be free from and project beyond the carriage at least as much as shown at C D, as the muzzles must clear the port, and the gun-carriage cannot run out further than B.

Approximately-muzzle-pivoting guns cause their muzzles to wabble up and down, in a diminished port truly, but with a very restricted vertical arc; but a very restricted arc is very unsatisfactory and

inefficient—for in the future, turret ships, will not only have to counter-batter their adversaries at low angles of elevation; but with 20° or 25° elevation for their guns, they will have to run in and bombard high surrounding land works, to be silenced and overcome in no other manner.

These elevations will never be got by any other than absolute muzzle-pivoting carriages, at least if a small embrasure is thought necessary; with a large one, as heretofore, the present system is simple and efficient.

I read a paper "on muzzle-pivoting gun-carriages for naval armaments," on the 3rd instant, at the Society of Naval Architects, in corroboration of the advantages of which system, the Assistant Constructor of the Navy, Mr. Barnaby, thought, that "I (Captain Heathorn) would be "glad to hear that the Brazilian Government, who had been engaged in "war, and who had been very successful, had had ships built of different "forms, but that their latest was a casemate vessel of 1,000 tons burden, "in all essential particulars like the old 'Research,' except in the par-"ticular that the guns fitted to her were muzzle-pivoted. The only "serious defect they had observed in the ships, was the largeness of "the ports, and, considering that the river was very narrow in the "front of the forts with which they had been engaged, it had been "a most serious matter to them."

Admiral Halsted also observed, that "immediately before he had "left Paris one of the last visits paid to inspect his new system was "by Lord Lyons, and on showing him the mode of elevating the "guns, he had said that if the Northern American monitors had had "such means of elevating their guns, it would have put a stop to the "warfare many months before. They could not elevate their guns, "and they did not dare to list their ships for fear of exposing their "bottoms."

This statement strongly backs up the necessity for having muzzle-pivoting gun-carriages, so constructed as to allow the guns to be laid at high angles of elevation, and be well protected from enemies' bullets pouring in through the ports. At the same time Mr. Mallet said, as a matter of fact, that he could state "that a 12-ton gun, giving 10° of elevation, and 15° of depression, could with muzzle-pivoting, be manœuvred between the decks with the arc which at present existed, leaving some inches to spare." He endorsed entirely what I had said as regarded the importance of muzzle-pivoting, stating that, "whatever might be the height of the port, if you had a muzzle-pivoting gun, there was no room for water to come in. And that whether on land or at sea, the larger you made the embrasure the more you weakened the structure of a shield."

I now conclude my paper, Mr. President and Gentlemen, by thanking you for your kind attention.

Captain MITCHELL, R.E.: Though not an Artillery Officer, but an Officer of Engineers, I should like to ask Captain Heathorn a question. Captain Heathorn has informed the meeting that the War Office rejected his gun-carriage as inapplicable to the Service. Has he any objection to tell us the reasons the War Office gave for not adopting his gun-carriage? Probably, they gave those objections in detail; and no

doubt it would be very interesting to the meeting to hear the reasons that the War Office assigned.

Admiral Sir HENRY CODRINGTON: There are one or two questions on the subject that I should like to ask. First, as to the stability of the gun at sea when elevated; because, as it is elevated considerably, the movement of the ship would then have much more effect than when it is at its lowest position. Next, whether any of the thrust of the gun, or the recoil of the gun in short, comes upon the bolt that I see at the cascable, or what actually bears it? What takes the thrust of the gun? I should also like to ask him a question as to the ease with which the damage that may be made by an enemy's shot, or by accidents and the wear and tear that there is in action, may be repaired?

Lieutenant-Colonel CONYBEARE, R.A.: I think Captain Heathorn stated that one of the advantages of his lever principle was that it afforded the means of elevating the gun on the old method, by moving it on its trunnions in case the lever got out of order. Perhaps he would be kind enough to explain to us what arrangements he would adopt for doing that?

Admiral CODRINGTON: I understand that the whole weight of the 12 tons is to be raised each time on the levers—the whole weight is to be raised on those cogs?

Captain HEATHORN: No, the weight is divided between the fulcrum and the cogs.

Captain MITCHELL: There are a large number of garrison carriages in the service. If Captain Heathorn's carriages are brought into the service to supersede the present carriages, I should like to ask him how far he could adapt the existing garrison carriages so as to meet the requirements of the plan which he proposes to introduce?

Captain HEATHORN: In answer to Captain Mitchell's first question, of the reasons why the Government objected to my carriage, I have never had such a definite explanation that I could give him. "Inapplicable to the service" has been the great reason urged. I never could get very deep into the subject, therefore, I regret to say I can give Captain Mitchell no further information upon that point. As regards the adaptation of the present garrison carriages to muzzle-pivoting, I do not think the present old wooden carriages would be very useful; and perhaps it would scarcely be desirable, because they are for mounting smaller guns than we are constructing. Now I do not think any alteration in that particular way would be an advantage. Muzzle-pivoting gun-carriages will only be used with minimum embrasures. Minimum embrasures with their expensive shields will only be afforded to very prominent positions. Then, again, I very much doubt whether the whole course of fortification at the present time is not undergoing a considerable *boulversement*. It is just a question whether shields, except in very particular positions, or rather I may say permanent works, will not have to give way to another system of artillery, of which my friend Captain Moncrieff is the originator, and which I believe in for certain purposes. As regards the stability of these muzzle-pivoting carriages in a sea-way, both in broadside and turret ships, I think you will remember that I propose to place rings or such fastening gear on the top of my carriage, as would in a sea-way fasten broadside carriages in a position of stability to the upper deck. In turrets I propose, as shown in Admiral Halsted's models (to be placed in the South Kensington Museum), so to construct the top of the carriages, that they may run under guiding rails, and prevent that upsetting which would occur by the oscillation of the vessel. As regards the recoil being taken by the bolt, it is a thing which I think is extremely objectionable; but I regret to say it is what the Government have adopted in their last construction, where they have used my levers, and have taken, as will be seen in the number of "The Engineer," of April 20th, 1868, the whole of the recoil on the bolt. I suppose they have a good reason for it, but I am unable to find it out. In the case of repairs to muzzle-pivoting gun-carriages, as in everything else where anything like mechanical attributes are used, duplicate parts must be provided. There are not many required in my construction; there are not many in most constructions; but duplicate parts would be provided. There would be spare levers; there would be a spare screw gearing. If the screw-gearing gave way, the ordinary handspike and quoin arrangement, with a purchase from the top if they can get it, or pressure from below, will be brought in to work the gun through space. The arrangements for converting the gun into a trunnion-pivoting gun would be very simple. It would be merely to

knock off the levers, then it would be a trunnion-pivoting gun. One of the models on the table shows it very well; take off the levers, and it becomes a trunnion-pivoting gun.

Admiral CODRINGTON: It would not then work through the ports.

Captain HEATHORN: A gun on that model would not, but one on the other would; it has, you notice, an oscillation below the screw.*

Mr. ROBERT MALLET, C.E.: I beg to make a few observations, if not too late, on the paper of Captain Heathorn. As I claim to be myself the first and original inventor of muzzle-pivoting ordnance, it could not be supposed that I intend to say anything in dispraise of the general principle of muzzle-pivoting. I must, however, say that Captain Heathorn, in stating that in the event of a muzzle-pivoting gun being disabled, you could revert with it to the ordinary method of trunnion working, is to claim for muzzle-pivoting a power which it does not, and on no possible construction ever can possess. Therefore, I hold that Captain Heathorn is entirely in error in that opinion. You cannot by any mechanical arrangement, re-convert a muzzle-pivoting into a trunnion gun, if you are to derive the advantages which muzzle-pivoting is intended to offer, and without which it is of no value, viz., the reduced aperture. Captain Heathorn will agree with what I say, and I think he must inadvertently have made his statement, that that is one of the advantages of muzzle-pivoting. And it is not unimportant that it should be corrected, because the very essence of muzzle-pivoting is this, to reduce the aperture through which the gun fires, to the size of the muzzle of your gun, so that except at the moment when the gun is withdrawn by the recoil, it is not possible for a shot to enter the hole at all. Therefore it is not likely that the gun will be dismounted in the way that ordinary guns are. It is quite possible it may be dismounted by a shell bursting inside; or it is just possible it may receive a downright facer by a shot coming through the hole and striking the muzzle; or it may be deranged more or less by a shell bursting inside. In all these respects the muzzle-pivoting carriage is on a par with the old constructions, but in its main advantage of the reduced aperture, it is far before them. There are various plans already produced by different persons for practically carrying out this method, or "system," as it was called. That construction will practically be best which is the simplest and cheapest, provided it fulfils the conditions required for perfect muzzle-pivoting. The great point to be attended to in the design of a muzzle-pivoting carriage, is to get a carriage of the simplest possible construction. It should have as few parts as possible beyond the existing carriage. There should be nothing above the level of the gun itself at any time; and it should be such that, if a naval gun, you could pin the whole thing down to the slide, and pin the slide down to the deck; so that no matter what movement the vessel might take, the gun could not by possibility get loose. As an inventor and a patentee of muzzle-pivoting, I do not think it would be graceful were I to criticise that particular construction invented by Captain Heathorn, and referred to in the paper. On the importance of muzzle-pivoting itself, Captain Heathorn and I, and other inventors, are thoroughly agreed. It is *the* point presented for the improvement, as regards the future, of mounting ordnance. There may be other plans, such as that of Captain Moncrieff, which offer great advantages, perhaps. I myself was one that saw vast difficulties in making that system practically useful, for it is one thing to make an exceedingly ingenious looking machine, but to make one that shall stand the rough usage of actual warfare, is another thing. Muzzle-pivoting is the mode to be adopted with ordnance to fire behind the shields of casemates, for if you want to make a strong shield you

* Captain Heathorn wishes the following memo. to be inserted:—"I thought "Admiral Codrington meant, that if the levers were taken off it would not work as a "trunnion-pivoting gun-carriage, hence my reference to an oscillation below the screw. "I never wished in any way to state that my muzzle-pivoting carriage minus the "levers, could produce muzzle-pivoting. What I wished to explain was, that without "levers it was a perfect trunnion-pivoting gun-carriage, the same power applicable in "both cases. The advantage of a gun-carriage, with both muzzle-pivoting and trun-"nion-pivoting action, is, that one pattern is better than two."—ED.

must have a small aperture in it. But a few years ago the authorities flouted the idea of muzzle-pivoting as utterly absurd; they have since altered their views, and a member of the Ordnance Select Committee itself has even become an inventor and a successful one of one form of muzzle-pivoting carriage. I believe that the authorities are now at last quite alive to the importance of the method. They are, however, taking a very questionable mode of getting the problem best solved by getting this or that Officer or person to adopt without acknowledgment, portions of plans devised by others, and precluding inventors from having their methods completed and fairly tried under their own direction. Some of the designs which I have seen, said to be on board the "Minotaur," are certainly only worthy of being called attempts to evade the rights of inventors.

The CHAIRMAN: I wish to ask Captain Heathorn whether the pattern of the carriage he sent for the "Captain" has been adopted or not?

Captain HEATHORN: Here is the drawing that I sent up to the Admiralty, at their request. They were going to adopt it; why they did not I have not yet heard.

The CHAIRMAN: It has not been adopted?

Captain HEATHORN: No, except that this (referring to the drawing in the "Engineer" of the Government carriage) was brought out at the Arsenal afterwards.

The CHAIRMAN: I think I am only expressing the sense of the meeting when I offer to Captain Heathorn our thanks for the paper which he has read to us this evening. The subject is one which is very nearly new, and like many similar subjects which have had, if not their origin, certainly early notice in this theatre, it will produce results which I have no doubt will be considered in a national point of view as of great importance, while it is creditable to those who have brought it forward. There appear to be some differences of opinion in respect to the arrangements of this muzzle-pivoting carriage, which Captain Heathorn has brought before us; but there is no doubt whatever—and I quite agree with what has fallen from the talented inventor, who last addressed the meeting—that for the future muzzle-pivoting will be *the* system. With regard to guns on shore, fortifications as well as artillery are undergoing a transition; they are now in a state in which nothing can be considered as settled. Much is under experiment; much will probably have to be altered, although we may have the elements of what the future will be, both of guns and of fortifications. But as regards ships, this system appears to me to have pre-eminent excellence, inasmuch as it reduces the ports through which the guns are fired, to their *minimum*—it admits of guns being trained to almost any requisite amount, and elevated or depressed through very many degrees without the aperture into which the muzzle of the gun is forced being enlarged unnecessarily in either direction. There appears to be one point which has not been noticed with regard to the ports for these muzzle-pivoting guns. It is in respect of their training, that a large portion of the iron-plating has to be cut off, to admit of the gun being moved laterally. Now, it is evident that this weakens to a certain extent the armour-plating of vessels. But we must take into account the extreme improbability of a shot hitting one of these ports. If we take the diameter of a port at 14 inches, which will give a surface of one foot, and take the side of a ship as between 3,000 and 4,000 superficial feet, the chances that the shot will hit that hole are as 3,000 or 4,000 to 1; that is almost saying that they would not hit at all. But not to enter into a discussion on a subject of which the discussion is closed, I will merely offer on the part of the meeting our thanks to Captain Heathorn for the valuable paper which he has read, and urge him to persevere in his invention. I trust the same success will follow his endeavours to bring forward this carriage, and other modified carriages on this system, as has happily attended the efforts of others who have favoured this Institution with explanations of their inventions, and which have had for their object, the improvement of our defences. I am sure that we all feel greatly obliged to Captain Heathorn, and to other Officers who come forward with the same good will that he has shown to-night, and demonstrate such beautiful illustrations of their systems as hang upon these walls, and who initiate here inventions of great national importance, and which cannot fail to make their way among continental authorities, as well as with our own Government.

LECTURE.

Friday, May 8th, 1868.

MAJOR-GENERAL SIR H. C. RAWLINSON, K.C.B., M.P., in the Chair.

THE MILITARY ADVANTAGES OF A DAILY MAIL-ROUTE TO INDIA THROUGH TURKEY AND THE PERSIAN GULF.

By HYDE CLARKE, Esq.

IN the year 1859 I had the honour to read before the members of The Royal United Service Institution, a memoir* on the adoption of the hills of India as strategic bases, instead of the plains. The object of the system of hill occupation and settlement I advocated, was to increase and strengthen the European element in healthy positions, not only as a means of repressing insurrection, but as a barrier against invasion from the north. The necessity for protective measures on that side has not become less in ten years. I now take advantage of this opportunity to bring before the members of the Institution another subject closely allied in ideas and principles.

The means of communication with our armies in India by any route, is of value to us, but the simple transport of troops may not be the sole consideration. This, quick steam transports can accomplish by sea route around the Cape. Still, the speediest means of conveying intelligence and Officers charged with special duties, is a matter of military necessity under emergencies; thus we are led to consider the land routes. That by Egypt accomplishes our objects to a considerable extent; but such are the contingencies to be regarded, that we cannot, in prudence, restrict ourselves to one route, were the Egyptian route even the shortest attainable. Thus all routes that can be opened are of value, even including the far northern route by Russia and Persia. This, from various circumstances, is being fully and rapidly developed, and

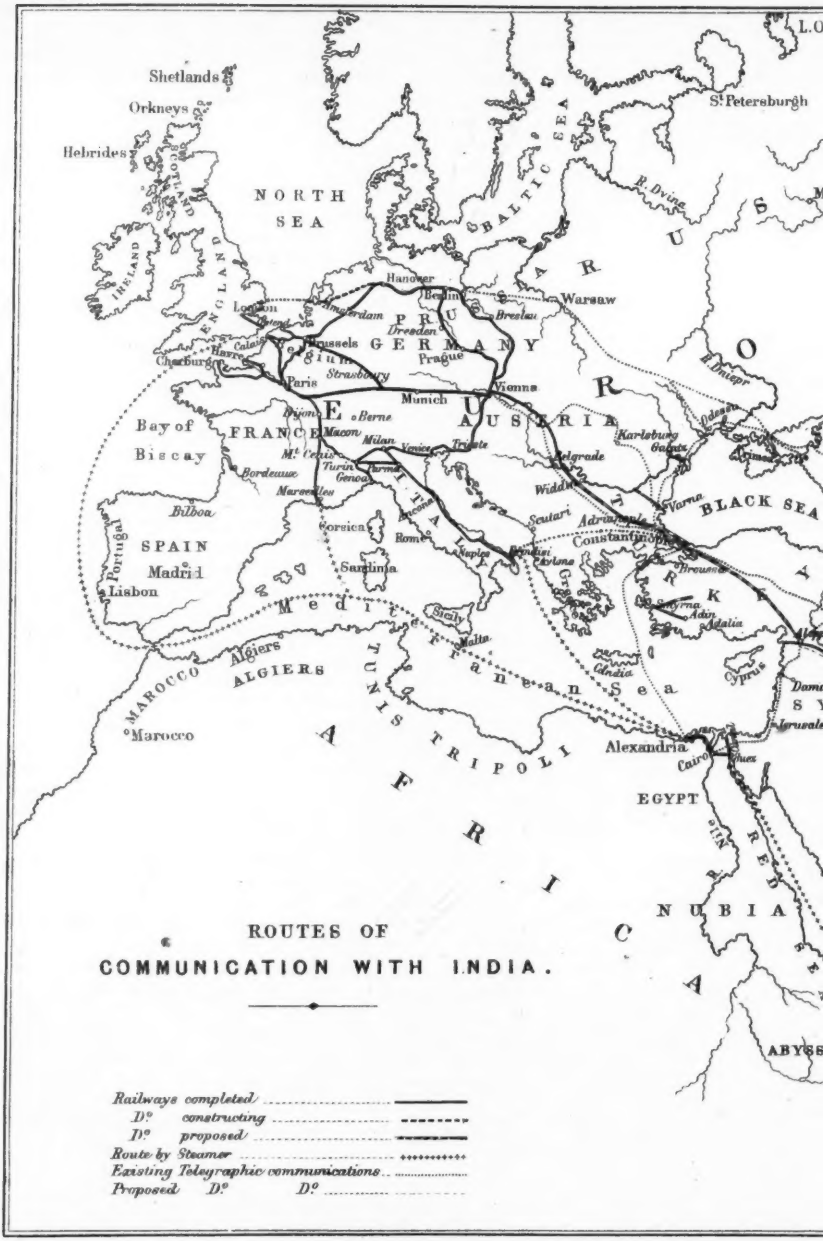
* "The Organization of the Army of India, with especial reference to the Hill regions," see Journal of the Royal United Service Institution, vol. iii, page 18.—ED.

we may before long find, that the routes which are really intended for attacking us are more advanced than those which ought to be available for our assistance and defence. We have at the present moment only one overland route, and that of a precarious character—the Egyptian one—one considered by some persons to be essentially English, and yet it is one liable at any time to be interrupted by the efforts of the Viceroys of Egypt to accomplish independence, or by the preponderance in that country of some foreign power.

There is another route—the middle route—which has only been partially explored, and never put in practice. I mean that route by the railways of Europe, Constantinople, Asia Minor, the Valley of the Euphratês, Bagdad, Bussorah, and the Persian Gulf, with which, for nearly fifty years, the name of General Chesney has been inseparably connected,* and in the promotion of which so many distinguished members of this Institution have taken part. The time is now fast approaching when, if we do our duty, we shall complete this great undertaking, and if we do so, we shall effect very much more than the construction of a railway route, for we shall, at the same time, and without separate or further outlay, accomplish great political operations, which will not only strengthen our military resources, but tend thereby to protect ourselves and Europe and Asia at large, from the danger of attack.

In considering a subject of this kind, it is fortunate that it can be brought before an audience which is not commercial, and which can therefore properly appreciate its moral elements, for although, after all, military administration must ultimately rest upon material resources, and, therefore, really and truly enter into the domain of political economy in the operations of capital; yet capital is not the only element of such and other transactions in the world, nor the sole aspect under which they are to be regarded. It is the misfortune of political economy, because it is its essential condition that capital shall be chiefly regarded, and as political science is in this country less studied and developed than the science of political economy, it does happen, not only in commercial circles, but also in the Legislature, that technical considerations of political economy often acquire too much preponderance. Thus when our political existence may be the question really at stake, the discussion may be made to turn on theoretical considerations of Government interference, and, therefore, operations of capital. While we have been arguing these principles, and leaving the middle and Euphrates' route to the action of the speculators of Europe, the French Government has devoted its energies to the Suez Canal, and the Russian Government to the execution of its land road to Persia. Therefore, under these circumstances, it is fortunate that the matter has to be discussed by a profession so far untrammelled by the primary prejudices of theoretical science, and accustomed to deal with questions under their moral and political aspects, those, in fact, by which this and many others must really be decided; because the

* See Paper read at the United Service Institution, by General Chesney, in 1857.—Ed.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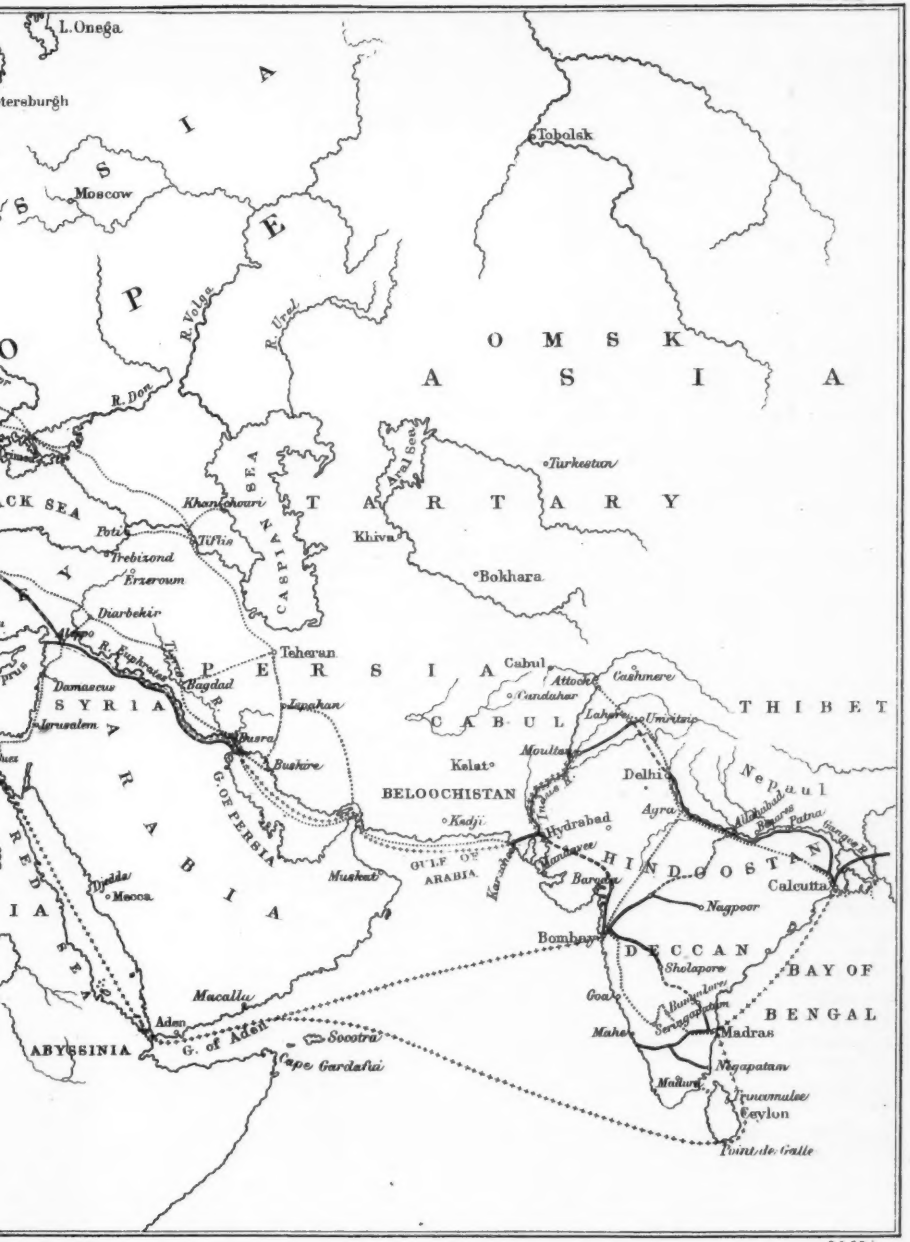
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welfare of commerce depends on the maintenance of peace, and for this the exact percentage of returns cannot be regarded. So far as the railway before us is a matter of reproductive enterprise, it is to be left to the volition of capitalists, but so far as it is a matter of political necessity, it must be urgently provided for, and not left to the chance of a Brazilian railway presenting more profit, or of a Portuguese railway affording a larger margin of shares to be appropriated by the promoters. The result may be, nay, has been, that in leaving this undertaking to the free-will election of capitalists and speculators, their preference has been shown for railway and other works, of no material benefit to our political interests.

This, therefore, is the issue on the present occasion; and it is the true issue before the Governments of England and India, and before the Legislature, to determine whether the route is really practicable, justifiable, and of essential necessity; if so, it then lies with the authorities interested, to find the best means of accomplishing the task, with the least disbursement of the national resources. It is idle to ask whether the undertaking will pay such and such a dividend, if it be in reality a necessary portion of our political machinery. It will then be fortunate if, instead of being like much of our military material—utterly unproductive—it should afford the means of ultimately repaying the requisite outlay. This is the true mode of regarding the subject, not beginning at the wrong end, and seeing whether it is, in the first instance, captivating to capitalists, but whether, in the first instance, it is necessary and beneficial to us as a nation.

The general course of the route has been already sketched. It is a short and direct route to India, and with which, only modifications of itself, can compete. The European railway system reaching to Basiash on the Danube, is the first and existing portion. The second is that lying between Basiash and Constantinople in Turkey in Europe. The concession for this has been granted to a combination of Belgians, English, and Hungarians, under the name of the Vander Elst and Company. At present the company is weak, and Turkish finance is weak, so that no very brilliant career can be augured for it, but this may safely be predicted, that the enterprise will be accomplished. There are portions of the line valuable for local purposes, for which the Ottoman Porte will obtain its resources, and the new political ambition of Hungary will encourage the extension and development of its railway system to the East.

The third portion is that concession granted to Mr. Greig, Messrs. Sharpe, Stewart, and Co., and Baron Winspeare, being the line of railway from Constantinople or Scutari, across Asia Minor to Aleppo, and thence by what has been called the Euphrates Valley Railway to Bagdad and Bussorah. The short concession from the Ottoman Government to the Euphrates Valley Railway Company having lapsed, this route forms an integral part of the new concession, and not, as has been lately described in some papers, a separate and distinct route. The third or Asiatic portion may be divided into two sections, the Northern and Asia Minor section, and the Southern and Euphrates Valley section.

The fourth portion is now in activity by the running of steamers between Bagdad, Bussorah, and Bombay. It will ultimately be replaced by a line of railway connecting Bussorah and Kurrachee, and joining the European to the Indian systems.

There are thus two portions of the route in activity, one in progress, and the remainder, the Scutari and Bussorah Railway, only in embryo, but without the execution of which we cannot obtain the advantages of the entire route. The topographical features are those which would interest many members of this Institution, and the discussion of which would be of great benefit, from the local knowledge they can bring to bear on the subject. This would, however, require time. It will be sufficient to say, that on the northern portion, the chief difficulties are in the northern mountains and in the passage of the chain of the Taurus.* The latter are the most considerable. On the southern section, the chief portion is easy, but the branch from Aleppo to Skanderoon or Alexandretta passes over a mountain range. The portions surveyed are from Scutari to Ismid and Eski Sheher, and from the Mediterranean to the Persian Gulf. Much of the line would be remunerative from local traffic, but in the present state of Turkish finance, its construction on such grounds cannot be expected.

The Turkish guarantee is 5 per cent. on £20,000 per mile, but this guarantee must be dismissed from the mind. It is of no immediate value, and only ultimately available as a collateral security. No one has, therefore, proposed to raise capital on this guarantee, and many newspapers have been led in error to discuss the project as dependent on this guarantee. The consideration of such guarantee must be abandoned, and the undertaking must be established on a different basis. What are of value, are the several sources of revenue appropriated by the Ottoman Government to the undertaking. Such are the Indo-European telegraph revenue, the Indo-European postal revenue, and subsidies from the several governments, the transit duties of 1 per cent. on merchandize, and the revenue of the passenger and goods traffic. Thus the Ottoman Government has, so far as it can, transferred to the new undertaking all its own available rights and revenues, and there can be no doubt that it would be further disposed to assist. The cost of the line is estimated at twenty millions, a sum which is considerable, but not beyond the resources of the enterprise.

If the railway could be economically constructed, and worked for a few years, no competent authority doubts but that it would yield a fair return, but no one who has experience believes it can be at once remunerative. What, therefore, is wanted is such assistance in credit as will raise the money on the lowest terms, and cause the least outlay for interest, and also such temporary accommodation as may be required during the early stages, to be repaid from the ultimate resources of the undertaking and the collateral guarantee of the Ottoman Porte. The burden of the whole of this temporary accommodation to the home and Indian governments would not be

* See a paper by me, "On the Daily Mail Route to India," in the Society of Arts Journal, vol. xvi, p. 275, Feb. 28th, 1868.—H. C.

heavy, while the revenue and political advantages would be great; but there are other governments which have political and commercial grounds for sharing in the operation. The pecuniary assistance would take the shape of postal subsidies, and in the end there would not even be pecuniary loss.

The military aspect of the question may be regarded under three heads.

1st. The conveyance of intelligence.

2nd. The conveyance of Officers, soldiers, and small stores.

3rd. Defensive and offensive resources, resulting from political consequences.

Rapid intelligence is at all times an essential military necessity, and the first element in effective movements. If this is the case in the field, or in a campaign, it is of the greater moment when the army of operation is so far removed from its real base, as India is from England. This was most sensibly demonstrated during the mutiny. Our Governments have since then devoted much attention to the improvement of the telegraphic and postal communications. An essential part of the telegraphic communication has been established by the middle route now under consideration, and it requires little argument to show that its maintenance is imperative, even if a cable route should be laid south, and particularly in consequence of the Russo-Prussian route being made effective.

Postal communication has its absolute military value apart from commercial value. In neither case is this value determinable by the pecuniary return in postal revenue. It includes the transmission of orders, reports, requisitions and returns, and the quicker the transmission, the more effective will be the condition of discipline and administration. As by the southern route, railway transit can at the utmost be extended to Brindisi, while through Russia it must be circuitous, so by the middle route is it direct, and the quickest mode available.

This brings us to the point of what is the period within which, mails can be conveyed by the middle route. Taking 25 miles per hour in the first instance by railway, and 10 miles by sea, this will give us—

London to Bussorah	144 hours	6 days
Bussorah to Bombay	160 „	$6\frac{2}{3}$ „
Total		$12\frac{2}{3}$ „

By acceleration of railway trains at a more advanced period, and assuming a rate of 30 hours, we get—

London to Bussorah	130 hours	5 days
Bussorah to Bombay	160 „	$6\frac{2}{3}$ „
Total		$11\frac{2}{3}$ „

From Bussorah to Kurrachee the voyage would be about 5 days,

giving a total transit to Kurrachee of 11 days in the earlier periods, and 10 days on greater acceleration, thus realising Lieut. Waghorn's prophecy.*

With a railway along the coast, at a speed of 25 miles per hour, the distance from London to Kurrachee will be ultimately accomplished in 8 days, to Bombay in 10, and to Calcutta and Madras in 10 or 11 days.

Some persons will make a very small account of the saving of one day between London and an Indian station, but the saving is more, for there is the saving of the day on the return mail, and on the future correspondence. In this instance, so soon as the railway is extended to Bussorah, instead of a weekly mail to India, we should get more frequent communication, and with a complete railway transit we should obtain to all India what we now have to most parts of Europe—a daily through mail.

Thus at present the course of post to Bombay is 51 days; this will be progressively reduced to 25 days and to 20 days, giving us 18 courses of post in a year, instead of 7, and materially increasing and improving the communication of Departments, and of course rendering still greater facilities in connexion with the telegraph. In 10 days a document could be obtained from most parts of India, or a written or detailed order transmitted thereon application by telegraph. The private advantages must be correspondent to the public benefits.

The second head for consideration is the conveyance of Officers, men, and small stores. For Officers despatched in cases of emergency, there would be the same acceleration as for mails, and in case of need, an Officer could pass from London to India in 8 or 10 days. This would not be the ordinary course, though on emergency an Officer could visit England or India and return in a month. In the more usual way some portions of time would be spent in repose, or in seeing the more remarkable cities on the way, and thus the journey would be prolonged. In case of need, sleeping accommodation would be provided in the trains, and the mode of travelling which is now adopted as far as Basiash would be extended to Bussorah, and ultimately to Kurrachee.

There are many obvious reasons why the main body of troops going to and returning from India should not be sent through Europe by railway; but still the route may be materially shortened and facilitated as compared with that through Egypt. The route for troops will be by steam transport from England to Scanderoon instead of to Alexandria, from Scanderoon by the Aleppo branch and so to Bussorah, and thence again by steam transport, with the advantage of passing by the Persian Gulf instead of by the Red Sea.

It will be seen that the Euphrates Valley section becomes, in case of need, an independent means of communication reaching from the Mediterranean to the Persian Gulf, and available as an alternative communication with the northern line, and more particularly available if the northern section be stopped. In its early stages, and as an alternative, it affords a route from Brindisi, Trieste, or Salonika to Scanderoon, and thence by railway to Bussorah.

* See Journal of the Royal United Service Institution, vol. x, p. 287.—H. C.

The undertaking has consequently to be considered under a double aspect, as a through line connected with the European system, and as an Euphrates Valley line.*

In the conveyance of Officers, troops, and stores, these routes would give us very great advantages, and the Euphrates Valley route would be accessible to us so long as we maintain naval communication by the Mediterranean or on the Indian Seas.

In these respects, the undertaking has a strong claim on our Governments for contribution and support.

We now come to the third head for consideration, viz., the political relations of the middle route; and here it may be useful to pass briefly over any questions affecting Western, and more particularly regard Eastern Europe, where exist the chief elements of difficulty and danger to the peace of the world.

Austria and Hungary will, by the extension of their railway system to the east, accomplish an ardent desire, and obtain another channel for commercial development as well as for the advancement of their eastern provinces. In a political point of view, this double empire has the greatest interest in effecting these objects, because it would be strengthened on the frontier most threatened and assaulted, the eastern and north-eastern. Austria would thus be enabled to take an effective part on the Lower Danube, and give military assistance to her chief eastern ally, the Sultan.

The nature of the route throughout, is such that it affords a secure military base, well within the frontiers and districts exposed to attack, and, indeed, were the line from Basiash to Bussorah laid down by military men for purely military purposes, it could scarcely be better devised. What it wants to complete it, is, sets of lines from this base to the scenes of attack, and these will in due course result from its execution.

The nature of the main line is this. From the Austrian junction, it admits of Austrian troops being thrown in along the whole line at the back of the Danube for the protection of that frontier, and, in case of need, of operating on the south against Servia. The European line provides for the movement of Turkish troops from Constantinople or the reserves in Asia for all purposes of defence, and for the protection of Bulgaria, as the Varna and Ruschuk Railway assists in the east.

At Constantinople contingents from the western powers can be landed and conveyed into the interior of European Turkey either for active purposes, or as a reserve, or as an army of observation in support of Turkish or Austrian troops.

From the moment that the Basiash or Belgrade and Constantinople line is in operation, the political situation of the Principalities will be changed. Now, not only the Servian Slaves lean to the threatening power of Russia, but the Rouman-speaking Wallachians are compelled to truckle to a hostile state. There is nothing on the spot able to coerce or to protect Roumania or Servia except Russia. On the other

* See Captain Tyler's paper "On Routes of Communication with India," Journal of the Royal United Service Institution, vol. x, p. 276, 1866.—H. C.

hand, an allied army of English, French, Austrians, and Turks would be able to defend Roumania against its natural enemies, and compel Servia to obey its engagements with the European powers. Our resources could be made available because the route touches the sea at several points. At Constantinople there is access to European and to Asiatic Turkey. By the Gulf of Scanderoon our fleet could land supplies for Asia Minor or the Euphrates Valley route, and at Bussorah we should have the facility of landing Indian auxiliaries, and of forwarding them throughout Mesopotamia and Asia Minor.

It is this power of co-operation, which would render active proceedings unnecessary, for the knowledge that the forces of England and France could be brought to bear on regions hitherto inaccessible, would alter the whole of the eastern political relationships.

Turkey, it will be seen, would be decidedly strengthened in Europe, but none the less in her great reserve of Asia. It is on the Asiatic side of the Scutari and Bussorah Railway, that the turbulent and little controlled tribes of Koords, Turkomans, Arabs, and others, are chiefly placed; these furnish little in money or in men, while they cause expense to the treasury, harrass the military forces, and prevent the settlement and cultivation of the country. By bringing strong bodies of troops to bear on insurgent or disobedient tribes, order has in all ages been alone maintained, and it is in this way that of late, the rebels of Koordistan and of Little Armenia have been reduced. The Turkish empire would be relieved from sources of expense and weakness, while the produce of the east, now unavailable, would fertilize the commerce of the west.

In the course of time, other branch lines would approach the frontiers and produce equivalent effects. Indeed, prosperity, the efficient promoter of order and civilization would be propagated throughout Asiatic Turkey, brigandage would become an ill-paying trade yielding more certain disaster than profit, and the empire would possess greater revenues, more troops, and better means of disposing of them.

We now come to a great and populous state, which, notwithstanding all our interest in it, has during this century been isolated and abandoned to the invasions of Russia, I mean—Persia. It would be worth while to make her strong, while she is yet disposed and able to maintain her independence. This will be the result of bringing her within the European system, the railway network of which, will be continued to her borders, bringing them within five days' reach of London and Paris. Within a comparatively short time, Teheran will be brought as near these capitals, as Constantinople lately was. This is no mean thing. It is, it is true, the conveyance of a letter in five or six days, but in the case of a country like Persia, it means everything which can result from admission into the sphere of western civilization. Persia is now busy with her short trial railway, and has granted concessions for a whole railway system, but bring her within a week of the capitalists of London and Paris, and it becomes possible for their trusted agents to examine, to negotiate, to receive instructions and authority, and to act effectively. Thus capital is made contributory; but, also, what is more than capital, knowledge and intelligence in the

application of European processes to native materials. To make Persia rich, to enable her to turn her own riches to her own benefit, is to make her strong at home and abroad. There are commercial interests which will induce France more readily perhaps than ourselves, to devote energy and influence to Persia; from any such operations we shall benefit.

To France, a new career of commercial and political ambition is opened more direct in its advantages than the Suez Canal, and one which binds her more strongly to her western ally. In the restoration and revival to political power of Turkey and of Persia, she must share, and she thus obtains an opportunity of asserting her position as a great power where Prussia cannot rival her; for in Turkey and in Persia, Prussia cannot as yet directly act.

The Suez Canal, interesting as that project is to France, cannot materially affect Persia, and it is only by the middle route that France can touch this newly awakened country. By the north, by the Russian railways she cannot touch it, and all that Russia does, is threatening to the political and commercial influence of France.

We see, therefore, in these various operations greater reasons for the maintenance and cementing of the western alliance, and thereby a stronger pledge for the preservation of peace; the greatest security is to be gained, however, by obtaining the means of placing the forces of the allied powers so as to protect those countries most exposed to attack.

Under such circumstances, for Russia to endeavour to coerce Turkey or Persia, would no longer be a safe proceeding, and she would have to concentrate her attention on Central Asia. At the present moment, the whole available force on 3,000 miles of exposed country, is 300,000 weak troops, to encounter the whole disposable power of Russia, assisted by naval operations on the Black and Caspian Seas, and having railway communication with the reserves on the rear. Under the combinations here described, the whole conditions may be changed by throwing into the exposed countries, 100,000 English and native troops, 100,000 French, and 200,000 Austrians; Roumania and Servia being neutralized, and the Greeks being compelled to desist from aiding the Russians or embarrassing the allies; whilst the fleets of England and France could convey to their own troops, and the contingents acting with them, the resources of their arsenals and the improved appliances of modern warfare.

Referring to some lesser results, Muskat, or Oman on the Persian Gulf, with which we have been long in alliance, and which exercises considerable influence on the coast of Mekran and the east coast of Africa, would also be brought within seven or eight days of England; and the growing trade between India and the countries of the Persian Gulf and the ports of Arabia would be promoted.

In a commercial point of view, this daily mail route, if carried out, will affect the postal correspondence of Western Europe with one quarter of the human race, will quicken the rapid development of India, and promote the revival of Asia Minor, Mesopotamia, and Persia. Politically and militarily, it will confer vigour and independence on the Empires of

Turkey and Persia, and will protect our own Indian empire by a chain of alliances and strategic combinations reaching from the Upper Danube to the Burhampooter. While these arrangements afford no means of attacking us, they allow military aid to be brought from Europe to contend with a common enemy in the eastern empires, and so defend by direct or by joint action, our own territory.

Such are the objects to be accomplished, and it may be desirable to consider the means of accomplishment. They consist in the hearty co-operation of our own authorities in the promotion of the requisite arrangements, and that more by moral action than by pecuniary contribution. One of the first steps is to secure, by negotiation, the concurrence and co-operation of France and Austria, for the advancement of their own interests. Another is to promote the adoption of postal treaties, not only with those states, but with Holland, and other powers having relations in the East. If our own great interests in India are materially promoted, so, to a greater or less degree, are those of other nations in Siam, the Archipelago, Manilla, China and Japan; the acceleration in transit affecting the whole of these.

A judicious measure, recommended by the *Pall Mall Gazette*, is that our Government should take charge of the surveys, as it did in the case of General Chesney's operations; but it would be far better, should our Government propose to the other Governments to take part in such a work.

In its results the undertaking would be truly international, as it would more closely unite the nations of the east and the west; it is therefore desirable that in its beginning, the states of Europe should act in concert and co-operation.

For carrying out the works and raising the capital, it is requisite that the money should be raised, not at the rates of eastern credit, 15, 20, or 25 per cent., but at European rates; to accomplish this, European state credit must be employed. This likewise would ensure the supervision of the several states for the economic administration of the enterprise, and for preventing jobbery and extravagance. If the capital be raised at 10 per cent., high tolls and high passenger fares will be expected; and as the English Government will be directly or indirectly the chief customer of the railway for its own purposes, or in the persons of its Officers, its interest is to secure moderate charges. The less the rate of interest, the sooner will any early advance of interest be re-couped and re-imbursed, and the sooner will a sinking fund be brought into operation for the extinction of loans. If the form of postal subsidy be adopted, and our portion of the subsidy be taken at $1\frac{1}{4}$ per cent. gross, and that of the Indian Government at $1\frac{1}{4}$ per cent., then the net liability will be less, as the several sources of revenue become available. The disbursement of the Governments will never be large, while it can be recovered from the Ottoman Government, and it may be so provided that the postal subsidy shall diminish in proportion to the earnings of the railway, so that in the end the governments will obtain not only a saving but a profit.

By combined action the operation will be easy, and the advantages be early realized, but this must be promoted by the formation of a sound public opinion, maintained by those most deeply interested, and

best calculated to exercise a judgment. If the commercial body possesses these qualities, so do the Military and Naval Members of this Institution, and particularly the main portion of them connected with our Eastern Empire. War, when honourably directed, being but the legitimate means of securing peace, so the maintenance of peace is the most honourable distinction of the soldier; but to achieve that, he must be able to support the prestige of his own reputation by the possession of real and absolute force. It is to the demonstration of these principles, and the accomplishment of results in accordance therewith, that this memoir is devoted, and it appeals to the members on two subjects of deep and vital importance—the safeguard of our Indian Empire, and the maintenance of European peace.

Evening Meeting.

Monday, May 11th, 1868.

MAJOR-GENERAL J. T. BOILEAU, F.R.S., in the Chair.

NAMES OF MEMBERS who joined the Institution between the 4th and 11th May, 1868.

LIFE.

Brooke, Charles K., Lieut. 15th Regt. 9*l.*

ANNUAL.

Sillery, Charles, Col. late 30th Regt. 1*l.* Batten, John Mount, Lt. 8th, or King's. 1*l.*
Stone, George H., Capt. R.A. 1*l.*

THE APPOINTMENT, AND PROMOTION OF REGIMENTAL OFFICERS.

By Colonel A. CUNINGHAM ROBERTSON, Commanding 2nd Battalion 8th or King's Regiment.

WHAT are the disadvantages and defects of the present system of the appointment and promotion of officers?

Can any better system be devised?

Supposing some other system to be better, would the advantages to be derived from adopting it be sufficient to render a change of system expedient; and, if expedient, are existing circumstances and opportunities such as to render a change practicable?

These are questions which have been frequently discussed in Parliament and by the press. Within the last thirty years they have been four times investigated and reported upon by Royal Commissions; once in 1840, again in 1854, a third time in 1857, and a fourth time in 1858.

I have no doubt that they have occasionally occupied the thoughts of most of those gentlemen whom I have this evening the honour of addressing.

The observations which I shall submit for your consideration will have reference to the two first of the three questions I have just stated.

By the question "what system of appointment and promotion is best," I understand, what system is likely to have the best effect in procuring the best class of candidates for military appointments; what the best effect in inducing the greatest proportion of those who receive commissions to devote themselves with energy and diligence to the study of military matters, and to the task of qualifying themselves for discharging, with perfect efficiency, the important and often very

difficult duties which devolve on those Officers who are appointed to the command of regiments and of larger bodies of troops.

This is an abstract question, which may be determined by reference to general principles—to the ordinary recognised motives of human action, and to the general conditions of military service. It, therefore, seems to me perfectly suitable for discussion in this place.

On the other hand the question—Is it expedient to make a change in the existing system?—is essentially of a practical nature. It must be determined not altogether, nor even principally, by the consideration of what is desirable; but chiefly by the consideration of what is expedient and practicable. Complicated financial calculations, the possibility of conciliating or compensating adverse personal interests, and the manner in which a change of system would affect the administrative details of promotion, must all be taken into account and carefully and minutely studied, in order to determine whether the advantages expected to be derived from a change are sufficient to counterbalance the difficulties of carrying it into effect.

It is evident that the discussion of complicated practical considerations of this description, could not be profitably attempted with the time at my command, and, indeed, even if the time at my command were unlimited, could not be satisfactorily conducted without the assistance of experienced officials thoroughly versed in all the administrative details of the subject.

I therefore wish it to be clearly understood, that although I entertain a very decided and confident opinion that certain changes in our present system are exceedingly desirable, and would, if effected, produce most beneficial results, yet I am well aware that the process of effecting these changes would be a most difficult and delicate operation; it would be opposed by so many obstacles and prejudices, it would be attended by so many inconveniences, it would inflict so great an amount of injury on individual interests, and create such strong feelings of discontent, that I am by no means surprised when I find that many Officers of high rank who have studied the question thoroughly, though fully admitting the evils of the existing system, yet look upon any proposal to change it, as most inexpedient, if not, as absolutely impracticable.

I shall not attempt to examine the grounds on which this opinion rests. I shall not even venture to express any opinion of my own as to whether it is correct or incorrect. Altogether waiving this difficult practical question, but supposing for a moment that the contrary opinion shall prevail, and that on the 19th of this month, when the question is again debated, it shall be decided by Parliament, wisely or unwisely, that the present system shall be changed, I shall endeavour to explain, as briefly and as clearly as I can, what other system would, in my opinion, be the best to substitute in its place.

If I succeed in convincing you that the system I shall have the honour of explaining to you is a good system, one that would work better and be more suitable to the conditions of military service in this country than Sir Charles Trevelyan's, or than any other which has been proposed, I shall be quite contented. If any one who goes with me

thus far, say "I admit all this, but still I am not prepared to admit that these expected advantages are sufficient to compensate for the inconveniences of a change," that person has gone very nearly as far as I myself am prepared to go. It is true that my opinion inclines the other way. It appears to me that a change of system which is indubitably very desirable, though difficult, ought not to be considered impracticable. I am inclined to think that a wise and vigorous administrator, heartily supported by the influence of a strong and popular Government, if he shared my belief, would find no insuperable difficulty in effecting the change. But this is a question on which I am well aware that I am not competent to form a trustworthy opinion. I therefore beg leave altogether to decline its discussion.

The suggested changes which I shall present for your consideration I shall not venture to recommend as being practically expedient and suitable for immediate adoption, but simply as being good in the abstract, and such as, apart from all considerations of the injurious effect they might have on individual interests, would so operate as to produce beneficial results.

The most convenient way of presenting the subject for your consideration will be, in the first place, briefly to enumerate the principal evils and disadvantages of the existing system, then to submit an outline of a system which it appears to me would not only be free from those evils and disadvantages, but would also so operate as to produce results highly favourable to the efficiency of the Army; and, lastly, to endeavour to illustrate and explain the manner in which the different provisions of the scheme would operate, and the nature of the results they might be expected to produce.

The following statement of the principal objections to the purchase system, is taken from the Report of the Commissioners of 1857. I omit those objections which are founded on the injury done to the interests of individual Officers; on the hardship and injustice frequently inflicted on Officers who, from their conspicuous abilities and the distinguished services they have rendered, have the strongest claims to promotion, but are passed over because unable to purchase. I shall only notice those objections which are founded on considerations of what is hurtful to the public interests, and injurious to the efficiency of the Army:—

The purchase system, in the opinion of many of the witnesses examined by the Commissioners, impairs the efficiency of the Army, by giving an undue pre-eminence to wealth, by discouraging exertion, and by depressing merit. Under existing regulations there is little inducement for Officers to acquire proficiency in the science of war. An Officer who performs his routine duties, and who keeps a sum of money available for the purchase of promotion as opportunities offer, may look forward with confidence to the attainment of high military rank. Hence when the responsible advisers of the Crown are obliged to prepare for the contingencies of war, and to recommend her Majesty to name a Commander for her armies in the field, they must necessarily select from among Officers who have risen by purchase, and who have ob-

tained their rank, not from proved capacity and acknowledged fitness, but from the current of promotion, and from having been able to avail themselves of opportunities of buying advancement.

This country will, therefore, commence the operations of a war under a disadvantage, as compared with those foreign states, where all the Officers on the higher grades have been subject to several selections, and may, therefore (if the power of selection has been honestly and wisely exercised), be relied on as men of proved efficiency and superior merit.

The substance of these and of other objections are summed up by the Commissioners in these words:—

1. The purchase system, it is said, restricts the number of those from whom Officers can, in the first instance, be obtained.

2. It deadens the feelings of emulation and the eagerness to acquire military knowledge.

3. It renders men eligible for the highest command without taking any security that they are fitted for such a position.

I quote the words of the report, but I may mention that, for reasons which I shall afterwards state, I do not attach any practical importance to the first of these objections.*

There is another objection not prominently indicated in the Report of the Commissioners, but which appears to me to be of as great, or even greater, importance, than any of the three they have enumerated. To this objection, as having been to a certain extent overlooked, I would invite special attention.

The practice of promoting in the same regiment, juniors over the heads of seniors, and thus reversing established relations of subordination and reciprocal obligations of command and obedience, is extremely injurious to discipline. The tendency of the practice is to render non-purchasing seniors averse to exercise their authority, and to render purchasing juniors impatient of control. It has also a tendency to foster in the minds of young Officers a feeling of indifference regarding the careful performance of routine duties, and of something like contempt for that species of professional merit which consists in a complete and minute knowledge of regimental work.

In my own experience I know two Adjutants each of whom was purchased over 14 times. Both these Adjutants were first-rate Officers. They had trained and instructed, from the time of their joining as recruits until their promotion, several of the Officers who became their superiors in rank.

Under a system which permits such scandals as these, it is quite natural, and a thing to be expected, that it is not considered a disgrace for an Officer to be grossly ignorant of his duty, and that the instruction of the Officers of a regiment is often a much more difficult, and a much more thankless task than the instruction of the non-commissioned Officers and privates, or (to use a somewhat different indication of the state of military feeling amongst Officers) that in some regiments this Royal Institution should not receive that amount of support which, con-

* Vide observations at p. 202.—A. C. R.

sidering the great professional interest of its objects, the admirable means it affords of promoting those objects, and the very moderate amount of the subscriptions it requires from its members, it seems fairly entitled to claim from the Officers of the Army.

Now, it is, I think, quite clear that this class of objections, viz., those which have reference not to individual interests, but to the interests of the State, cannot be obviated by substituting for the system of promotion by purchase, a system of promotion by seniority.

The system of promotion by seniority, is quite as destructive as the system of promotion by purchase, of all motives to voluntary exertion, and of all persevering and vigorous effort for the attainment of professional excellence.

The one system is quite as incapable as the other of affording any guarantee that Officers of rank shall possess the requisite natural capacity, and the requisite amount of acquired knowledge, to exercise efficiently the important functions of commanding a regiment, or larger body of troops. In point of fact, instances of manifest incompetency among Officers of rank are quite as frequently met with in the seniority service of the Royal Artillery as in the purchase services of the Guards, cavalry, and line.

Hence then we are driven to the inevitable conclusion, that the only possible mode of remedying the evils of the purchase system, is to devise some plan of comparing and testing the abilities and acquirements of each individual Officer, and of selecting those for promotion whom we have ascertained to be the most capable of performing efficiently the duties of the higher grade. The soundness of this conclusion is incontrovertible. It is admitted that it would be extremely desirable and beneficial to adopt the principle of selection according to merit, but we are told by the highest authorities that, having reference to the state of feeling in the Army, and to the social constitution of society, it is quite impossible to devise any plan of practically applying this principle which would produce satisfactory results.

Sir George Cornewall Lewis, in his speech on the motion made by Sir De Lacy Evans in May, 1862, for the abolition of promotion by purchase to the rank of Lieutenant-Colonel, said that though Lord Herbert was fully convinced that the proposed change was desirable, he was deterred from bringing forward any measure to give effect to his views because, when he came to consider the question closely, he found it was embarrassed by great difficulties of detail.

The only method of practically applying the principle of selection to the promotion of Officers, brought under the notice of the Royal Commission of 1857, and, therefore, probably the only method considered by Lord Herbert, was the French plan of committing the task of selection to the absolute discretion of the Minister of War, guided by the reports of Inspecting Generals.

His Royal Highness the Duke of Cambridge records his opinion regarding the inexpediency, or rather impracticability, of introducing this method of selection into the British Service, in the following terms :—

"My opinion is very decided that the power of selection is impos-

" sible, whether it be exercised by a military man, or whether it is to be " exercised by a civilian; and I do not think that any man having that " power would hold his position for six months in this country. Every " appointment is now so questioned and criticised that it would be " impossible to give good reasons for promoting junior men, and it " would come to seniority."

In the evidence given by Earl Grey, the same opinion is expressed. He says,—

" I am persuaded that during peace a system of selection in this " country is practically impossible. I do not believe that any Com- " mander-in-Chief or any Government would ever be able to exercise " that power of choosing officers, and they would take refuge from " attacks on the score of favouritism, to which they would be exposed " by any selection, by following blindly the system of seniority in time " of peace. The Commander-in-Chief for the time being would know " that when a lieutenant-colonelcy or a majority fell vacant, if he " appointed the next officer in succession, he would be comparatively " exempt from obloquy; but on the other hand, though he had a strong " opinion that there might be some very able officer in a junior rank, he " would not be able to prove it to the satisfaction of others, and he " would be afraid of the suspicion he would incur, and he would not " have sufficient firmness to do what perhaps the public interest required. " Under a free Government the difficulty of selection is much greater " than under an arbitrary Government. A man who has no account to " give to anybody of the principles on which his selection is made, looks " to nothing but his own judgment, and can act in a very different " manner from what can be done in this country."

Now, if no other expedient could be devised for carrying out the principle of selection, excepting that of entrusting the task of deciding respecting the relative merits of officers to individual discretion, I should certainly consider the opinions I have quoted sufficient to prove that in this country it would be practically impossible to work the principle of selection in a satisfactory way. Nor should I adopt that opinion merely out of deference to the great authority and eminent positions of the Royal Duke and of the noble Earl. The truth and force of the considerations by which their opinion is supported, cannot fail to be appreciated by every one acquainted with the feeling of the Army, and with the irresistible influence which public opinion in this country exercises over the conduct of affairs.

It appears to me, however, that these considerations which convinced Lord Grey and the Duke of Cambridge that it would be practically impossible to exercise the power of selection, do not apply to the principle of the system, but exclusively to the particular method adopted by the French, of giving practical effect to that principle.

Another method of giving effect to the principle has suggested itself to me, which is certainly simpler, which I think would be equally efficacious, and by which all the difficulties of carrying out the French method would be evaded. What I suggest is, that certain definite qualifications should be required from every officer as an essential condition of promotion. That qualified and unqualified officers should be arranged in

separate lists, and that the senior in the list of qualified officers should be selected for promotion. The qualification for promotion in the junior ranks being of a kind which none but the absolutely incompetent, or incorrigibly idle, could possibly fail to attain. On the other hand, the qualification required for promotion to the rank of field officers should be such as only allowed of its being attained by a limited number of officers distinguished by superior ability or favoured by special opportunities.

There would probably be considerable difficulty in fixing upon any qualification for promotion to the higher ranks which would be generally recognised as a satisfactory test of fitness for command; but whatever might be the nature of the qualification appointed by regulation as the condition of promotion, there would be no difficulty whatever in devising a method of ascertaining what officers possessed, and what officers did not possess, the requisite qualifications which would be regarded by every one as perfectly fair and satisfactory.

The Official entrusted with the duty of deciding respecting the qualifications of officers would not be required to exercise any arbitrary power of selection. He would only be required to exercise the functions of a judge to determine concerning a matter of fact capable of being ascertained by definite evidence. His decision would not be liable to be impugned as erroneous, either on the ground of want of discrimination, or of wilful partiality.

The following outline is intended to illustrate the manner in which a code of regulations might be framed for applying the principle of selection to the appointment and promotion of regimental officers in the method suggested:—

As regards the financial effect of the proposed regulations, it did not appear to me likely that Parliament would sanction any large grant of money for the purpose of effecting improvements in the promotion of Officers; indeed, I do not think that, due regard being had to more urgent military objects, a large outlay for such a purpose would be justifiable. I have therefore looked upon one of the essential conditions of the problem to be, that the change of system should be effected without expense, and I have accordingly so framed my suggestions that none of them involve any addition to the army estimates.

Outline of a plan for regulating the appointment and promotion of regimental Officers:*—

I. Regimental officers to consist of three grades, subalterns, captains, and field officers.

II. Vacancies in the establishment of subalterns to be filled up in the following manner:—A certain portion, say one-fifth, to be bestowed gratuitously.

1st. On pupils of the Military Colleges, selected by competitive examination.

2nd. On non-commissioned Officers specially recommended for dis-

* This outline was first published in the "Army and Navy Gazette" 28th of March last.—A. C. R.

tinguished conduct in the field, conditionally on their passing a defined educational examination.

3rd. On non-commissioned Officers specially recommended for superior ability and efficiency, and ascertained by examination to possess the same, or nearly the same, educational qualifications as those exacted from candidates for commissions not selected from the ranks.*

The remaining vacancies (viz., four-fifths of the whole) to be given to any applicant approved of by the Commander-in-Chief conditionally on his passing a prescribed medical and educational examination, and on his paying an appointment fee of such amount as might from time to time be determined by reference to the ratio existing between applicants and vacancies—small in amount during time of war, gradually rising during the continuance of a long peace. This appointment fee to be paid unconditionally, not subject to any claim for repayment on the Officer quitting the Service.

III. Vacancies in the rank of Captain to be filled up regimentally by seniority, conditionally on the senior having passed a prescribed professional examination. All qualified subalterns, if not previously promoted to vacancies in the establishment after a certain term of service, say 12 years, to be promoted by brevet, and borne on the regimental strength as supernumerary Captains. Captains after 25 years to be permitted, and after 30 years compelled, to retire.

IV. Vacancies in the rank of Field Officers to be filled up according to their Army seniority from classified lists of Captains possessing one or more of the following special qualifications, or of such others as might be established by regulation as suitable tests of superior ability, and the possession of which should be declared as an indispensable condition to render an Officer eligible for promotion to this rank:—

a. Brevet rank conferred for distinguished service and proved capacity in the field.

b. Having been selected for the appointment of Adjutant, and having performed the duties of the appointment satisfactorily for a period of not less than three years.

c. Having obtained admission to the Staff College by competitive examination, and received on quitting it, a certificate of possessing a thorough knowledge of all the subjects embraced in the prescribed course of study.

d. Any Captain reported by the Officer commanding his regiment, recommended by the Inspecting-General, and considered by the Commander-in-Chief to have established a claim to promotion, by the ability displayed in performing some special service, or by having in any other way evinced distinguished capacity.

Qualified Captains to be divided into three classes: the first con-

* To carry out these two suggestions in a satisfactory way, it would be necessary to establish a training school for non-commissioned Officers, similar to the Staff College established for training commissioned Officers. I may state that in my opinion the effect of adopting these regulations would be to diminish, not to increase, the number of promotions from the ranks; fewer would be promoted, but these few would, in respect of intelligence and education, be equal to the generality of officers. —A. C. R.

taining all those who possess the three qualifications *a*, *b*, and *c*; the second of those who possess any two of them; and the third to consist of those who possess any one of the four qualifications *a*, *b*, *c*, and *d*. Vacancies in the rank of Field Officers to be filled, first by Captains of the first class, in the order of their army seniority; then by Captains of the second; and lastly, by Captains of the third class, their seniority to reckon from the date of their commission as Captain, not from the date of their being placed on the qualified list.

The Regimental establishment of Field Officers to consist of one Colonel and of one Lieutenant-Colonel; the Colonel, after seven years' service, or on attaining the age of 60, to retire with the rank of Brigadier-General, and on the full pay of his regimental rank; the Lieutenant-Colonel to succeed to the vacancy.

V. Exchanges to be permitted in all ranks excepting that of Colonel commanding a regiment; the Officers exchanging not being placed at the bottom of the rank to which they belong, but each taking the same place as the other occupied in their respective regiments.

VI. No restrictions to be placed on Officers accepting money as a consideration for exchanging or for retiring from the Service.

It will be observed that the proposed provisions for the appointment of Officers, although modified by important differences of detail, are in their general principles substantially the same as those of the system at present established by regulation.

It is one of the indispensable conditions of a sound military system, that in the organization of the two great classes of Officers and soldiers, the artificial distinctions of military rank should correspond with real social differences of birth and breeding; that the Officers should possess such social advantages as should render them the natural leaders of those placed under their command; that they should possess a more cultivated intelligence, purer and more delicate feelings, more refined manners, higher and more scrupulous ideas of honour and duty.

As compared with other military systems, it seems to me a peculiar excellence of the constitution of the British Army that the social relation between the Officers and soldiers, is such as to render the exercise of command easy and singularly effective. In an Army recruited by voluntary enlistment, it is obvious that the low rates of military pay can, as a general rule, only secure the services of soldiers drawn from the most destitute and ignorant classes of unskilled labourers. On the other hand, the necessity for possessing certain educational qualifications, and for paying a large sum of money as the condition of receiving a commission, are provisions which, combined with the social consideration accorded to military rank, secure for the British Army, a class of Officers so superior to soldiers in social position, that the authority conferred on the Officers by their commissions is supported by a strong moral influence exerted on the opinions and feelings of the soldiers. This produces a relation between them and their Officers extremely favourable to the successful exercise of command, and extremely favourable for inspiring the soldiers with confidence in their Officers and respect for their authority.

In the French Army, on the other hand, where the soldiers are

drawn by conscription from all ranks of the population, where many soldiers serving in the ranks are in point of birth, intelligence, and education, equal to many of the Officers under whom they are serving, it is obvious that the relation existing between the Officers and the soldiers is unfavourable to the prestige of military authority and the efficient exercise of command, that it is difficult for an Officer, unless endowed with personal qualities of a very high order, to exert a powerful influence over his men, to inspire them with confidence and respect, and to obtain from them unquestioning, willingly accorded obedience.

As to the objections which are often urged against making a money payment a condition of obtaining military rank, I think it will be found on consideration, that all reasonable objections to the purchase system apply exclusively to that part of the system which authorizes the purchase of promotion. To require the payment of a sum of money as one of the conditions of obtaining admission to the military service, and of receiving a valuable appointment from the State, is perfectly equitable in principle. Considered with reference to the interests of individuals, it does not involve the disregard of any legitimate claim. Considered with reference to the interests of the public, the right of the state to demand that a price should be paid for a first commission, is perfectly analagous to the right of a master to require that a fee should be paid by his apprentice. The Officer on whom a commission is conferred, receives as an equivalent for the purchase money paid to the state, instruction in his military duties, and admission into a service possessing many advantages and many valuable privileges.

These considerations, I think, are sufficient to establish my opinion that the demand of an appointment fee is perfectly legitimate, a demand which the state is fairly entitled to make; and I think it may be shown that what is right in principle, is also expedient in policy.

The following are the reasons which, in my opinion, render it expedient to exact an appointment fee from the majority of those who apply for commissions:—

1. To make the expenditure of a considerable sum of money one of the conditions of obtaining a commission, has obviously a tendency to restrict applicants to a class superior in social position to the class to which the majority of those belong, who are placed under the command of the Officers of the Army.

The advantages of this difference between the social position of the Officers and soldiers of an army has been already pointed out. But without denying that this is an advantage, it may be objected that it is obtained at the expense of a greater disadvantage. It may be said, and it was actually said by several of the witnesses examined by the Royal Commission of 1867, that by restricting the selection of Officers to a particular class, many persons are excluded who, by their natural endowments, are specially adapted for the military profession, and thus the average ability of the Officers will be lower than if no money qualification were exacted from applicants for commissions. I think it must be admitted that every restriction which in any degree

narrows the field of selection must to some extent operate in the manner alleged. But so long as a considerable proportion of vacancies are reserved for gratuitous distribution among specially qualified non-commissioned officers and the most distinguished pupils of the military schools, and so long as no one is permitted to purchase a commission whose fitness for the appointment has not been ascertained by an educational examination, and by other suitable tests, I do not think that this objection need be accounted of much practical importance.

2. It is a great advantage to an Army if a considerable proportion of its Officers retire from it at an early period of their service. This quickens the promotion of those who remain, and diminishes the average age of those serving in the higher ranks. Now it is obvious that the number of Officers possessing sufficient private means to enable them to retire at an early period of their service, will probably be increased much in the same ratio as the value of the appointment fee is raised, and the proportion of applicants for commissions from whom it is exacted, is increased.

3. The payment of an appointment fee, liable to forfeiture in case of inefficiency or misconduct, is a pecuniary guarantee for the ability and good conduct of every one who pays the fee.

These three advantages, more or less directly connected with the system of making payment of money one of the qualifications required from applicants for commissions, have reference to the general conditions of military service; none of the three have any special reference to the circumstances of any particular Army. In whatever Army the system were introduced, its tendency would be to secure for that Army, the three advantages I have enumerated.

There is a fourth advantage which exceeds in practical importance the value of the other three combined, and which has a special and exclusive reference to the peculiar constitution of our own Army.

By exacting from between three-fourths and four-fifths of the applicants for commissions in the Guards, cavalry and infantry, an appointment fee, not larger than could be easily obtained without checking the present demand for commissions, a fund would be formed sufficient to pay the interest of the sum required to afford compensation to any Officer who chose to avail himself of the right conferred on him by existing regulations, to retire from the Service by the sale of the commissions he has purchased. Thus means would be provided of defraying the expense of abolishing the present pernicious system of purchase of promotion, and of substituting in its place, a system of promotion by selection, without adding a single shilling to the Army estimates.

In the year 1856, the Royal Commission estimated the total sum at that time invested in the purchase of commissions, to be about seven millions. But in calculating the amount which it would be necessary to raise in order to provide compensation to Officers for withdrawing from them the right to sell their commissions, it would be necessary to deduct from this estimate the value of the commissions; firstly, of all those officers who die in the Service; and secondly, of all those who, instead of selling out, prefer retiring on full pay, or remaining in the

Service until promoted to the rank of Major-General. These deductions would probably reduce the amount by two millions or two millions and a half.

On the other hand no doubt, Officers wishing to retire from the Service would claim, not only the regulation value of their commissions, but also the amount paid by them above regulation; and it is probable, that subject to certain limitations, equity would require that claim to be conceded. This would cause an increase, equivalent, or possibly more than equivalent, to the reduction stated above. Upon the whole, perhaps, seven millions may be assumed as a tolerably near approximation to the sum that would be required for compensation, if the present system of purchase were abolished.

Now, the interest of seven millions, at 3½ per cent., is £245,000; this sum, divided by 350, the annual number of vacancies which it is suggested might be disposed of by purchase, would give £700 as the value of the appointment fee requisite to be paid in order to produce this sum. I imagine this does not exceed what would be easily obtained in time of peace, without diminishing the number of applicants for commissions.

Of course it will be understood that I am only calculating what would be the average price necessary to be obtained for each commission—not that I mean to suggest that commissions in the Guards Cavalry and Infantry should be charged at the same uniform rate.

These are all the observations I have to offer concerning the appointment of Officers. I now proceed to the more important and much more difficult subject of their promotion from the lowest to the highest regimental grade.

I shall consider separately each of the four qualifications, the possession of one or other of which, I have suggested should be an indispensable condition to render a Captain eligible for promotion to the rank of Field Officer.

As regards the first of these qualifications, "Brevet rank conferred for distinguished service and proved capacity in the field," a very few words will suffice.

Every one will admit that distinguished service and proved capacity in the field are, beyond all comparison, the most valuable qualifications for command which an Officer can possess; indeed, there are many who think that these are the only test of fitness for command worthy to be relied on, who distrust all modes of discriminating between the degrees of merit possessed by different Officers, excepting that of comparing the services they have actually performed in the field of battle, and the manner in which they have conducted themselves in some critical moment, when valour and conduct have contended successfully against an enemy superior in numbers, or in the means and opportunities of making an effective attack.

If the services of an Officer really deserve to be qualified as distinguished, if his conduct has been such as to prove his capacity in a satisfactory way, his fitness for command and the advantage to the Service which will be gained by his promotion, do not admit of being questioned. In actual practice there would however be, no doubt, great difficulty in preventing favouritism, and in rendering it tolerably

certain that the services of every Officer should be accurately appreciated, and an impartial estimate formed of their value.

Perhaps the most satisfactory way of securing an impartial award would be for General Officers to refer all recommendations, on the ground of distinguished service, to a board of Field Officers instructed strictly to investigate concerning the truth and significance of the facts reported. The report of the Board, together with the opinion of the General who convened it, might then be referred to the Commander-in-Chief for his final decision. The claims of any Officer who conceived himself neglected, or unfairly judged by his Colonel, might, on his appealing to the General, be investigated in a similar way.

Of course, whatever precautions might be taken, occasional abuses could not be altogether prevented. Cases would occasionally occur in which Officers of rank and influence would abuse the trust reposed in them, and allow motives of friendship or of interest to determine their decision in exercising the duty of selection; but I am of opinion that such abuses would be much more rare under a system where the principle was, that promotion should be regulated by merit, than under a system where it was regulated by seniority or by purchase.

Where merit as tested by the possession of certain definite qualifications was the only recognised means of obtaining promotion, any very flagrant abuse of the trust reposed in the Officer appointed to perform the duty of selection, would not be tolerated by public opinion.

The second suggested qualification is "having been selected for the "appointment of Adjutant, and satisfactorily performed its duties for a "period of three years."

In time of peace I do not think it possible to devise a better mode of selecting Officers specially fitted for the command of regiments, than to fill up vacancies from a list of old Adjutants.

An Adjutant is first picked out from a body of Officers, because he possesses certain special qualities: because he is superior to the rest in intelligence, in energy, in zeal; because he possesses a special aptitude for the conduct of business and the management of men; then he receives a special training, which makes him familiar with all the details of orderly-room work and of parade exercises. Now those natural endowments and that special training which are required to constitute an accomplished Adjutant, are the very same that are required to constitute an accomplished Commanding Officer, hence there is an evident fitness in so regulating the promotion of regimental Officers, that the two appointments should be connected; that the one should be the stepping-stone by which the other should be reached.

According to the present system, the appointment of Adjutant is left entirely to the Commanding Officer. In practice the appointment is rarely or never given to an incompetent Officer, but it not unfrequently happens, that in the selection, interest and favour prevail over merit, and that the Officer selected, though competent to perform the duties of the appointment, is by no means the most competent and deserving among the subalterns.

2. There is no limit fixed as to the time during which the appointment may be held.

3. There is no provision made for accelerating the promotion of trained Adjutants to the rank of Captain.

Now in order that a sufficient number of specially qualified and thoroughly trained Adjutants may be available to supply a large proportion of vacancies in the rank of Field Officers, three things are necessary.

1st. That the original selection of the Officer for the appointment should be made with just discrimination, and with perfect impartiality.

2nd. That the period during which the appointment is held should be limited to the time necessary for acquiring a thorough knowledge of its duties, say to three years.

3rd. That provision should be made for the immediate promotion of trained Adjutants to the rank of Captain.

Now I think these objects might be secured by the following regulations :—

1st. At each half-yearly inspection, the General should call upon each Field Officer and each Captain to report to him separately the name of the subaltern he considered best fitted to succeed to a vacancy in the appointment. The General should forward to headquarters a list of the names reported, affixing to each, remarks expressive of his own opinion of the relative merits of the Officers. From these lists on a vacancy occurring, the Commander-in-Chief would select the Officer most favourably mentioned in the reports. When the Colonel and the majority of the other Officers agreed in recommending the same subaltern, of course all that the Commander-in-Chief would have to do, would be to confirm their selection; but when the Colonel recommended one subaltern, and the majority of the Officers another, he would probably rely on the opinion of the General. On all occasions where it seemed expedient to the Commander-in-Chief to fill up a vacancy by an Officer, not recommended by his Colonel, I think before making the appointment, it would be proper to communicate the name of the subaltern proposed to be selected, to the Colonel, and to give him an opportunity of submitting for consideration any observations or objections he might wish to offer.

2ndly. The Adjutant immediately on his appointment should take command and precedence of all subalterns; on completing his three years' term of service he should receive the brevet rank of Captain, and be borne on the regimental strength as a supernumerary, until a vacancy occurred.

I may mention that the Officers who at present hold the appointments of Adjutant and of Musketry Instructor in the battalion I have the honour to command, accepted the appointments on condition that they would resign them, after holding them for three years, and that when vacancies occur, there are other well qualified subalterns willing to accept these appointments on the same condition. I have reason to believe that by thus limiting the term for which these appointments are held, a very good effect will be produced in inducing young Officers to qualify themselves to succeed to vacancies, and I would respectfully bring the experiment I am making, to the notice of the authorities at

the Horse Guards, with the view of their considering whether it would not be beneficial to the Service to establish by regulation throughout the Army, the rule I have suggested. To permit, as is sometimes done, an Officer promoted from the ranks, and who, from his age at the time of his promotion, and from being unable to purchase, has little chance of ever obtaining command of a battalion, to hold the appointment of Adjutant for a long term of years, is in my opinion to deprive the younger Officers of a most valuable opportunity of obtaining the best possible training for fitting an Officer for the command of a battalion.

The third qualification I have suggested is, "having obtained admis-
"sion to the Staff College by competitive examination, and received on
"quitting it, a certificate of possessing a thorough knowledge of all the
"subjects embraced in the prescribed course of study."

I fear I must not expect that all who hear me will agree with me in thinking that the possession of this qualification might, generally speaking, be accepted as a satisfactory proof that the Officer who possesses it is likely to make an efficient Commanding Officer.

The connection between the endowments necessary to pass a successful examination, and the endowments necessary to command a regiment with energy and discretion, is certainly not so obvious as is the connection between the qualities which procure an Officer, brevet rank for distinguished service in the field, or obtain for him the appointment of Adjutant, and the qualities which fit him for the command of a regiment.

It is very possible that some of the Officers I am addressing may say, the moral and intellectual qualities usually possessed by distinguished students are entirely different in kind from those usually possessed by Officers who have the reputation of having been most successful in the command of their regiments. This I admit to be true, but I reply that practically it will be found that those Officers who succeed in competitive examinations, and in attaining proficiency in the course of study prescribed at the Staff College, are, generally speaking, by no means men of those devotedly studious habits and strong natural inclination for abstract speculations which indicate peculiar aptitude for obtaining distinction as a student. They are generally men not by any means particularly addicted to studious pursuits, but merely men endowed with more than average intellectual power, and more than average energy of will, who, believing that certain acquirements are necessary to their professional advancement and efficiency, devote themselves with strenuous and persevering efforts to the studies necessary for obtaining possession of these acquirements. The moral and intellectual qualities which enable men of this stamp to excel in an examination, are, it appears to me, the very same in kind as those which are required for the successful command of a regiment.

For these reasons, I am of opinion, that the possession of this qualification is of itself, generally speaking, a sufficient proof, that he who possesses it, will make an efficient commanding officer, and that it entitles him to be considered equally eligible for promotion, as those

who possess the qualifications of brevet rank, or of three years' performance of the duties of Adjutant.

One advantage of this test, is the facility of its application, and of its being in the power of every officer who possesses the requisite ability to obtain the qualification. Even in time of war and when a corps forms part of an Army engaged in active operations, opportunities rarely present themselves for an officer to perform any distinguished service. Out of many Officers capable of achieving distinction, accident determines to whom the opportunity shall be given. Thus, although services performed are the most satisfactory of all tests of individual merit, they afford no test whatever of comparative merit, and are therefore most unsatisfactory data for carrying out a system of selection.

The test of service as an Adjutant, although it is superior to that of distinguished service in the field, inasmuch as by its mode of application, it is a satisfactory test not only of individual fitness, but of comparative degrees of merit, nevertheless has the disadvantage of being limited in its application. It might possibly happen, that for every vacancy that might occur in the Adjutancy, there might be two or more officers well qualified to fill it. This is an extreme supposition, but no doubt cases would frequently occur, where it would be extremely difficult to discriminate between the merits of two Officers of nearly equal qualifications, and where the qualifications of the disappointed Officer might rather exceed than fall short of the average qualifications of Officers who had been successful in obtaining the appointment. The examination test is free from this disadvantage; it may be applied to every officer who desires to submit to it.

But perhaps the chief advantage of including this qualification as one of the tests in a scheme of selection, is the great additional security for efficiency, which is obtained when it is combined with one of the other tests, viz.:—Distinguished service in the field, or service as an Adjutant. It is to be presumed that every officer possessing either of these qualifications, would for the sake of obtaining the precedence of a doubly qualified officer, make an effort to obtain a Staff College certificate. Thus it would happen that a large proportion of Officers selected for the command of regiments, would not only have given satisfactory proof of ability as practical soldiers, and manifested their aptitude for command, either by their conduct in the field, or by their skilful performance of the duties of Adjutant, but would also frequently possess those additional and higher qualifications which it is desirable, those should possess, who are appointed to the command of large bodies of troops. They would be officers who possessed a competent knowledge of military history, and of the theoretical principles of the art of war; who were accomplished in all arts, sciences, and acquirements, applicable to the conduct of the offensive and defensive operations of war.

The 4th of the proposed qualifications, is "having displayed ability in performing some special service."

This provision is intended to meet exceptional cases of rare occurrence—such as courage and ability displayed on occasions of ship-

wreck, fire, pestilence, mutinies, civil disturbances, conduct of difficult marches, &c.

The same precautions might be taken to guard against abuses, by appointing a board to report on such recommendations as were suggested, to guard against abuses in recommendations for brevet promotion.

Suggestion V. "To permit exchanges in all ranks (excepting that of Colonel [commanding a regiment), each Officer to take the same place in the list of the Officers of his own rank as the other occupied," and

Suggestion VI. "To remove all restrictions on officers accepting money," are intended as provisions for promoting early retirements, thereby accelerating promotion, and conciliating personal interests. For the sake of still further promoting these important objects, I would recommend the permission, not only of regimental exchanges between Officers of the same rank, serving in different regiments, but also changes of position between Captains on the same classified list of Officers eligible for promotion to the rank of Field Officers. The manner in which, I think such arrangements should be carried out, is this: an Officer wishing to retire, or to exchange, conditionally on his receiving a certain sum of money, should make an application to the Adjutant-General, stating the terms he was willing to accept, and accompanied by the usual certificates that the application did not originate either in inefficiency or misconduct. If approved of, the application would be published in orders, and tenders invited for the money demanded. Subject to any discretionary power of selection, which it might be thought desirable to entrust to the Commander-in-Chief, in the case of an exchange, the offer of the senior Officer tendering the required sum would be accepted; in the case of a retirement as soon as the required sum was lodged, the senior in succession would be promoted. One or two illustrations will show how these provisions would work. First as regards retirements: suppose the Colonel commanding a regiment wanted to retire, it would be the interest of the regimental Lieutenant-Colonel, and of the Captain at the head of the list of those eligible for promotion, and of the senior subaltern of the regiment, to which the Captain next for promotion belonged, to make up the required sum. In the same way, if a Lieutenant-Colonel wished to retire, it would be the interest of the qualified Captains, and of the regimental subaltern next in succession to make up the required sum. The retirement of a Captain would, as at present, be a purely regimental arrangement, the only officers interested in the step being the subalterns of the regiment to which he belonged. In the event, however, of the subalterns being unable or unwilling to raise the sum required to secure the step, the proposed regulation respecting exchanges would afford a Captain the means of making arrangements with officers of other regiments for obtaining the sum he had fixed as the condition of his retirement. In the first place, if holding a good position on the list of Captains eligible for promotion, he might find an officer low down on the list willing to give the required sum for an exchange of positions; or, secondly, if he belonged to the list of un-

qualified Captains, it might be the interest of a qualified subaltern in another corps to induce the senior Lieutenant to exchange, and having effected the exchange to obtain his promotion by paying the sum required by the Captain desirous of retiring.

These suggestions for accelerating retirements are, I am aware, open to some objections, similar in principle, but by no means similar in their practical bearing to objections which apply to the purchase system. My suggestions are not proposed as faultless in principle, but as the best practical means I can devise of providing an inducement for early retirements sufficient to ensure such a proportion of these retirements as is indispensable to the successful working in time of peace of any system of promotion whatever.

The only other alternative that I can see, is to fix a short limit for the period of an officer's service in each rank, and to render the retirement of all who reach this limit compulsory; of course the adoption of this alternative would involve a very large expenditure for retiring allowances.

To prevent misapprehension, it may be well to point out the very great difference in its practical working between a system which recognises "*a right to purchase promotion*," and a system which does not recognise that right, but which "*grants permission to Officers of the same rank and in the same list as regards qualification for promotion to exchange positions.*"

The effects of a right to purchase are—

1st. That an Officer who cannot purchase may be superseded an indefinite number of times by the promotion of his juniors, without being brought a single step nearer the top of his rank.

2nd. That when he does become senior of his rank, an indefinite number of vacancies may occur in the ranks above him, to none of which the rules of the service permit him to succeed.

3rd. That all supersessions are regimental, and that consequently actually existing relations of military subordination and actually existing reciprocal obligations of command and obedience are reversed in a manner most injurious to the interests of discipline, and most hurtful to the feelings of the superseded Officers.

The suggested permission of Officers of different regiments to exchange positions, would produce none of these injurious effects:—

1st. An exchange of position between two Officers of different regiments does not affect the position of any other officer of the same rank, or in any way lessen his chances of promotion.

Whatever number of exchanges may occur among his seniors, each vacancy that occurs in the upper ranks, brings the junior officer of the rank below, one nearer to the top of the list, and when he becomes senior of his rank, if properly qualified, he succeeds to the next vacancy that occurs.

The effect of each exchange is merely to substitute one individual for another among his seniors. However numerous such exchanges may be, they do not increase the number of steps necessary to bring the junior to the top of the list, or in any way obstruct the effect of each vacancy as it occurs in the rank above, raising him a step on the

list, and thus contributing, exactly in the same manner, to his advancement as if no exchanges had taken place among those above him.

2nd. Although it might happen that an Officer exchanging positions was junior in the service to some of those placed below him in the regiment into which he exchanges, yet this supersession would reverse no previously subsisting personal relations and, therefore, would not inflict any injury on discipline by the reversal of reciprocal duties, and of the established order of regimental subordination. The case would be much the same as when a young Captain, under the present system, exchanges into a regiment where many of the subalterns are much senior to him in the service. This supersession is not so injurious to the interests of discipline, nor is it so hurtful to the feelings of individuals as when a young subaltern purchases his company over the heads of his seniors.

It is obvious that one of the effects of establishing a system of promotion by selection, would be to render those Officers anxious to retire from the service who failed to obtain the qualifications necessary for promotion. As compared with the present system the effect of the proposed system would therefore, I think, be both to increase the motives and to increase the facilities for early retirements.

If this anticipation were realized, two great advantages would be obtained :—

1. The average age of officers would be diminished.

2. The country would be relieved from the obligation of compensating officers for any sums they might have expended in excess of the regulation prices of their commissions, and the sum required for this purpose would, therefore, be reduced from seven to probably not more than five millions.

Having now explained the manner in which I imagine the different changes I have suggested would work, I shall conclude by briefly stating the advantages which I believe would result from substituting the proposed system of appointment and promotion, for that at present established by regulation :—

1. A powerful motive would be given to induce officers to exert themselves to excel in their profession, which motive to a greater or less extent, during the early period of their service, would operate on every officer without exception.

2. As the result of this stimulus to exertion, the average amount of acquirements, and of the professional ability of the officers of the Army, might be expected to be considerably augmented.

3. All officers appointed to the command of regiments would be picked men ; in every case officers of proved ability, and in most cases, men not only of superior natural capacity, but also of superior professional acquirements.

4. The command of a regiment would be attained at a much earlier age than it is at present.

5. Officers of inferior capacity would have stronger motives for retiring from the Service than they have under the present system, and the facility of effecting early retirements would probably be found to be greater than it is at present.

6. The pernicious practice of purchasing promotion would be abolished without any charge whatever being made against the public revenue on account of the seven or five millions necessary to be provided for compensating officers for the money expended in the purchase of their commissions.

In making this comparison, the existing system to which I referred was, of course, the purchase system, which regulates the appointment and promotion of officers in the household troops, cavalry, and infantry of the line, but I wish to take this opportunity of stating a very strong, and I trust a well considered opinion, that whatever advantages in point of efficiency would be gained by substituting in these branches of the service a system of promotion by selection for the system of promotion by purchase, the same advantages in a still higher degree would be gained by substituting in the artillery branch of the service, promotion by selection for promotion by seniority.

It seems to me absolutely essential, both to the general efficiency of this most important branch of the Service, and also to the individual interests of the Officers composing it, that whatever be the system of promotion adopted for the other branches of the Service, the same system should be established in the artillery.

The great difference in the rate of promotion, and in the average age of Officers, which now exists between the artillery and the line does not altogether depend on the difference between the effect of the principle of seniority and the principle of purchase. In a great measure it depends upon these two different systems being brought into competition in the same Army.

If seniority were the regulating principle of promotion in all branches of the Service, no doubt promotion would be slower in all of them than it now is in the cavalry or infantry, but in none of them would it be so slow as it is in the artillery, working under the condition of being brought into competition with the purchase system.

The effect of this competition is, that the whole of that class of Officers who retire from the Army after short periods of service are attracted to the cavalry and line, and that, almost without exception, those Officers who enter the artillery belong to a class who complete their full term of service before they retire.

Now, if the system of promotion were the same in all branches of the service, the distribution of the class of Officers who retire early, would be very different. The proportion attracted to the artillery would, from the natural advantages of this branch of the Service, be greater than that attracted to the line, and the rate of promotion in the two services would undergo a corresponding change; that of the artillery would be accelerated, that of the line diminished.

Perhaps it may be objected that the Officers who retire early, generally feel little interest in their duties, and no interest at all in scientific pursuits, and are, therefore, quite unfit for the artillery service. But I think it a fallacy to suppose that Officers who belong to this class, generally speaking, feel less interest in their duties than those of the class who devote their lives to the service. Young, energetic men make good Officers, and perform their duties zealously, whether they

intend to remain 10 or 50 years in the Service. I think it a still greater fallacy to suppose that, as an actual matter of fact, the majority of Artillery Officers are men of scientific tastes, or to suppose that if the majority of the Officers could really be imbued with such tastes, their practical efficiency and capacity for performing their duties, either in quarters or in the field, would be materially increased. The art of fighting guns is a matter of rule and practice which is easily acquired by any intelligent Officer. In the junior ranks of the Service, courage, energy, intelligence, presence of mind, and practical experience, are much more essential to the successful working of a battery in the field than high scientific attainments. As there are many skilful navigators who know little or nothing of the science of astronomy, so I hope it is no libel on a body not less distinguished for scientific attainments than for conspicuous gallantry, to say that there are many excellent Artillery Officers who are very indifferent mathematicians, and anything but proficient in the theory of projectiles.

I feel convinced that by making the appointment to the majority of vacancies in the artillery dependent on the payment of a fee, and by making the possession of certain prescribed qualifications an essential condition of promotion to the rank of Field Officer, not only would the rate of promotion be increased, and the general efficiency of this branch of the Service improved in a corresponding ratio, but that the average qualifications of the Officers in respect of scientific attainments would be raised, and that the number of Officers eminent for their complete mastery of the whole science of artillery would be even greater than it now is.

Colonel PONSONBY, Grenadier Guards: Colonel Robertson has told us that he is against promotion by seniority and against promotion by purchase. I cannot help thinking, that if he allows commissions to be sold at their market price, that will be introducing a new system of promotion by purchase. Instead of being purchase by regulation, it will be purchase for anything that Officers can get. I do not exactly see how the two will work together—how the promotion by selection and the promotion by purchase will ever be able to work together. The Colonel of a regiment who finds himself near the end of his period of service, will make his bargain with the senior Officers of each rank; and, of course, each Officer, probably, would sell out according as the time came. That I think would be another system of promotion by purchase. Some of the points in connection with promotion by selection are well worthy of consideration; and, particularly that about the Adjutant. I am not quite sure that three years is long enough; I should have thought five years would be better. But Colonel Robertson, I admit, has had more practical experience than I have had.

Colonel ROBERTSON: You would not have a sufficient supply unless you shortened the period.

Colonel PONSONBY: That is true.

Sir CHARLES TREVELYAN, K.C.B.: I have been attracted here this evening by the extreme interest of the subject before the meeting, and I have not been disappointed. We have heard some very valuable observations. I am especially pleased to see that Colonel Robertson has not been afraid of introducing to a great extent the element of selection in promotion. He has laid down some excellent rules, which must form the foundation of any system that hereafter may be adopted in consequence of the abolition of the system of purchase. It must be observed that Colonel Robertson's argument assumes the abolition of purchase. It assumes that the country will consent to pay a large sum in compensation to Officers, not

only for what they have invested in their commissions according to the regulation price, but for those extra prices which have been paid according to the custom of the Army, and with the full knowledge of the authorities. It also assumes that Parliament will provide a system of retirement at the public expense in the place of the system of retirement by purchase, which is really at the expense of the Officers themselves. It also assumes that, as the Army is to be more than ever a professional Army, professional rates of pay will be given in substitution for the present obsolete and totally inadequate rates. As the country will make these great sacrifices, of course it will expect to obtain value for its money: it will expect that not only those changes will be made which are necessary for the perfect efficiency of the Army, but also those which are required to be made, in order to make it an open career for every class of our population, and to make it a national training school of the utmost possible value. In order to make any useful observations, it would perhaps not be advisable for me to take particular points, but as briefly as I can to take a general view, founded upon Colonel Robertson's plan. Everybody will admit that the Army must, in the main, be officered from the upper class of society. The upper class is the most highly educated class. From their position in the social scale they are formed to habits of command, accustomed to command from their earliest childhood. The classes below them are accustomed to submit to their authority, and the upper classes are the special depository of the traditions of Christian chivalry which inculcate truthfulness and personal honour, and all the high moral qualities which belong to the character of the gentleman. But security must be taken that the superior education, which is the special recommendation of this class, really exists; in short, that the country obtains the services not only of members of that class, but of worthy members of it; of those who have prepared themselves for the important duty of commanding their fellow-men, and having in trust their happiness, their prospects in this life, and, as a Christian gentleman, I must say, in a high degree, their eternal prospects. I do not know any opinion which is so generally accepted, especially by experienced military men, as that our public schools, in which I include not merely the old public schools, Eton, Harrow, Rugby, and Westminster, but a very large number of proprietary schools and colleges which have arisen in various parts of the country on the model of those old public schools—it is admitted—it is no longer open to argument, as will be seen, on reading the evidence given before the Purchase Commission, by Officer after Officer, with Lord Clyde at their head, that our public schools are the true nurseries for the Officers of our Army. Not so much for the book learning that is obtained there, as for the moral training; the knowledge of character, of life, and manners; the acquiring in the beginning of life, habits of obedience and of command; and the high and honourable tone prevailing, for in all these schools, as most of us can say from our own personal experience, there is a prevailing public opinion which on all main points is of a highly honourable and manly character. For this purpose, in order to obtain a full school education, in order that the young men may not be obliged to leave school prematurely, and with the name of having been at a public school, may yet fail to obtain the benefits of a public school—for we all know that the greatest benefits are reaped in the higher forms—the age for entering upon the military profession should be fixed, so as to allow them to pass through the sixth form, I should say, not under the age of 18. That completes the general education of the young men. Then comes the special education. In every other profession it is considered necessary that the candidate should undergo a preliminary professional training. Why not in the Army? Is it not more necessary than ever in the Army? The Army is eminently a profession; it has its science. It has its history, and its science. All the manœuvres, evolutions, and tactics are eminently scientific, and require a previous training. Therefore, in my opinion, every young man who has finished his general education and is intended for the Army should go through a course of special professional instruction in a military college. The admission to the military college, as proposed by Colonel Robertson, should be by competitive examination. But on this point great care must be taken so to arrange the examination as to exclude that most pernicious system of "cramming," which has grown up outside our public schools. The true mode of discouraging "cramming"

was that which was pointed out by Lord Macaulay in reference to the competitive examinations for the Indian Civil Service, namely, to exclude from the examinations every obligatory attainment, not only everything that is technical, but every obligatory attainment; to examine the young men in what they may have happened to learn, whether it be classics, or mathematics, or foreign languages, or natural science, or whatever it may be, provided it fairly comes up to the idea of a liberal education. If the young men are examined in what they know, not in what they are required to go out of the way to learn, the occasion for cramming disappears—it cannot arise. That plan has been followed by the Civil Service Commissioners with great success. Then every step of these young men's progress in this military course will be of the nature of probation. There will be two distinct objects in the military college. One will be to make it a probation, so that those who have mistaken their profession, who have not the self-control, or the good principle, or the natural capacity to enable them to pursue it with advantage may be weeded out, and may not be left to enter the Army, and then to be got rid of, to the disadvantage not only of the public service but of themselves. Of course, the rudiments of the military profession should be taught there: military science, surveying, military history, and so forth, with drill and military discipline. Every young man leaving a military college should at least be able to put a company through its manœuvres, so that when he joins his regiment he may teach his men, and not have to be taught and drilled by his men. In fact, he should join his regiment fully prepared to enter at once on the effective discharge of his duties. If these great advantages, of a free commission, of pay sufficient to enable him to live by his profession, with retirement at the public expense, are given him, the public has a right to expect that there shall be no waste, and that the young men shall commence at once, after they join their regiments, to do effective public duty. With every respect for Colonel Robertson's opinions, I must say that I entirely differ from him as to requiring a previous payment. It involves a logical absurdity, to increase the pay of the young men, or even to give the present pay, inadequate as it is, with one hand, and then to take it away with the other. It will not stand the test of real examination. And it is very undesirable that a young man should enter a profession, especially the Army, burdened with pecuniary obligations. It is an essential condition of efficient service in any profession that a man should be able to live by that profession. Then we all know that the most valuable class of young men in all professions, in the law, the church, in civil engineering, and in every other profession except the Army, are the young men who have not capital in money, whose capital is only in their character, their industry, and their attainments. Who are the men who rise to be Lord Chancellors and to all the high offices in the law and the church? They are not young men of fortune. They are young men who have lived laborious days, who work hard, and have only their education, their training, their ability, their industry, perseverance, and patience, to depend upon. Now, any payment, however small, has a strong tendency to exclude that most valuable class of young men. I now come to the other great source of providing Officers, the other great element, namely, the promotion of non-Commissioned Officers to be Officers. This will draw persons of all classes into the Army, adding to its other great attractions that of making it an open career by which competence and distinction may be attained. At present only the highest and the lowest classes of our population are represented in the Army. The Officers represent the highest stratum of society; the soldiers represent the lowest stratum. But since that model was fixed for our Army at the Restoration, the bad political and moral time of the Restoration, English society has developed in an extraordinary manner. In the last 50 years, within my own recollection, it has made extraordinary progress. It is difficult to describe it. Look at the multiplication of employments—railways, manufactures, mercantile business (mercantile business in my youth was not one-twentieth part of what it is now), colonies, civil engineering, India—so many employments which occupy our energetic middle class, that class which has had the largest share in making our country what it is. Education has also greatly developed; national education, popular education, has spread far and wide throughout the country. The improvement in middle-class education is, more especially, a sign of the times—so that the classes

between the highest class, now represented by our Officers, and the lowest class, represented by the rank and file, are immensely developed. Numerically they are the most important; in industry and intelligence they are far the most important. And why should not this great middle portion of our people be represented in the Army? Why should not the Army be a true representation of our nation? We see how Austria went down before Prussia. The main cause of that was that the Prussian nation was in their Army; every class was represented there. It was not so in Austria. And again in France every portion of the population, through the system of conscription, is represented in the Army. There that great end is obtained through conscription. Here we may equally attain it through our voluntary system, provided we make the Army an open career for all classes of our population. See the admirable result which would follow this great change! how the intelligence and *morale* of our Army would rise. The *morale* of the Army would be pitched at the standard, not of the lowest class, as it is now—I mean the rank and file, including, as it does, too large a portion of the scum of society—but of the intelligent middle class. See the immediate consequences of such a change; and these are only part of what may be expected. Our pothouse system of recruiting would be at an end. The Army at present is the sole instance of a line of life which does not furnish a provision for life, which furnishes no career, no means of rising, no means of satisfying that natural craving which God has implanted in the breasts of men for improving their condition. Why should the Army be the only line of English life which is deprived of that great motive? When that is set right, and when the British Army has become a place for the whole British nation, then the recruiting difficulty will be got over. Bounties will be no longer required. It will be a privilege to be admitted into the Army, and a punishment to be dismissed from it. The recruiting staff may be largely diminished; in fact, altogether dispensed with. Instead of our touting in the public-houses, sweeping the public-houses for the off-scouring of our youth, the best of them will come to us and ask as a privilege to be admitted into the Army, as they do now to be admitted into the police. As for flogging, there would be no occasion for it; and those large establishments, the military prisons, with the great expense attending such establishments, and keeping the prisoners, the escorts, and all the other arrangements, we shall hear very little of them, because an effective punishment, the only effective one, will be dismissal from the Army. But I fear that I am trespassing upon the patience of the meeting.

The CHAIRMAN: Not if your further observations are not very long; the time is passing by, and perhaps some other gentlemen may wish to give us their views.

Sir CHARLES TREVELYAN: I shall pass very rapidly over the rest of what I have to say. The Army will thus be made a profession for the whole population; the military authorities would have a much wider selection. Instead of selecting from one class only, they would select for the ranks of non-Commissioned and Commissioned Officers from the whole of our population. That strong native undersoil, which the Bishop of Lichfield alluded to the other day, would be largely turned up, and the nation would have the benefit of it; the opportunities and facilities for selection would be perfect. No competitive examination, in fact no examination at all, would be necessary, except to see that the persons promoted had the requisite education, because examinations, after all, are a make-shift, they are a substitute for the real thing. The real thing is to have the man before you performing his duties, so that you see him in his whole character and conduct, and see whether he possesses those high qualifications which are requisite for promotion; the practical result would be much as it is in the Prussian Army, where candidates are promoted from the ranks, but only after they have been approved of by the whole body of Officers of the regiment, because, although the responsibility of making promotions would rest upon the Commanding Officer, he would be very much influenced by the recommendation of the Officers of the regiment. There could be no mistake, because there would be no uncertainty; they would know the whole man; he would be entirely before them. The regimental schools should be greatly improved so as to give the non-Commissioned Officers and privates, facilities for studying their profession and qualifying themselves for promotion. And, in my opinion, though it is no suggestion of mine,

—it is suggested by a much higher authority than I am—a Captain Instructor who has passed at the Staff College, should be appointed to each regiment to guide and assist the studies of both Officers and men, and, of course, to superintend the regimental school. I would observe, with reference to a suggestion of Colonel Robertson's, that great caution should be observed in admitting "distinguished service in the field" in the case of a non-Commissioned Officer or private as a ground for promotion, because the question now is, fitness for bearing Her Majesty's Commission. A soldier may perform an act of great daring, and yet may be the last person qualified to be promoted to a commission; it would be injurious to the public service and also to him that he should be so promoted. It would be far better to reward him in some other way. The result at which we have arrived is, that we should have two classes of Officers; the distinguishing feature of one class would be superior education, of the other, practical experience. Those two elements properly manipulated would combine every practicable security for proper qualification. There is no room for any third class; if introduced, it must be wanting in some of the requisite conditions of efficiency. All that now remains is, to determine in what proportion the Officers shall be composed of those two elements. The larger proportion of commissions should be assigned to the candidates from the military colleges, because, first, the predominance should be secured to superior intellect and education; and, secondly, while Officers promoted from the ranks would generally follow their profession to the close, many of those admitted from the military colleges would enter the Army only for a few years, as they do at present. I hope that habit of our young men of fortune serving for a few years in the Army will never cease. So that, whatever the proportions of the two classes might be at first, they would be likely to be altered in the end in favour of those promoted from the ranks. Therefore, the proportion of those promoted from the ranks should be less than of those who come from the military colleges. The French system of promotion is, that one-third of the appointments to commissions is given to *sous-officiers*. The Prussian, Austrian, and Russian systems are that young men of family and liberal education descend into the ranks and serve as privates with a view to early promotion as Officers, performing all the duties of privates and being promoted to be Non-commissioned Officers, but only associating with the men in the ranks more or less according to their education and personal habits. Of those two I think the French system is greatly to be preferred, because it opens the military career to the whole nation; because it gives a greater choice; because it produces Officers of greater military experience. In fact, it is the difference between taking a small class who are sent into the ranks to learn their business, and taking the whole body of the rank and file and non-Commissioned Officers, and selecting the best among them. I now come to the subject of promotion, on which I will only make two or three observations. In my opinion there should only be four ranks of Officers below the general Officers—two company—Lieutenants and Captains—and two field—Lieutenant-Colonels and Colonels. Whatever the reasons may have been for having six ranks originally, I think they no longer exist. It is very desirable that the system should be simplified; a host of difficulties would be got rid of by doing so. The two field ranks, in my opinion, should also be Army ranks, as they are in all other Armies. The British Army is the only Army in which the field ranks are merely regimental ranks. Then up to the rank of Captain the rule of promotion should be seniority—tested by examination, and qualified by selection—modified by selection. The examination would be first, the practical professional examination which is constantly going on through the Inspecting General Officers, which, of course, is of the utmost value. In the French service the promotions are made yearly upon that examination combined with the reports of the regimental Commanding Officers. I conceive that after a young man has been a few years in his regiment, under the observation of his Commanding Officer, and he has been reported upon by several Inspecting Officers, he becomes thoroughly known, and, as he rises, his fitness for command becomes more fully known, so that really there can be no mistake at all. The other examination would be in professional science, previous to his attaining the rank of Captain. Then those supplementary tests pointed out by Colonel Robertson—the Adjutancy, the

Staff College, and "special services"—are of the utmost value, and, of course, would come largely into consideration. Lastly, I would only observe that I am against the modified system of purchase proposed by Colonel Robertson. To allow of exchanges by purchase, in which the new principle would be introduced, of the Officer purchasing, actually taking the place of the Officer with whom he exchanges, would be returning to the old purchase system in a more objectionable form. It would be purchasing over the heads of any number of Officers, and merely by money an Officer might get on as fast as he does now, indeed I think faster. I think an absolute prohibition ought to be placed on Officers accepting money as a consideration for exchange or retiring from the Service, because although, undoubtedly, the worst part of the present purchase system is the purchase of promotion, yet the bonus system, as it is called, is also open to great objection. I will read a sentence from a letter which entirely expresses my experience and opinion. I will not say whose it is, it will speak for itself:—"This (that is the bonus system) is to re-intro-"duce purchase in a form which, to my mind, has little more to recommend it than "what you wish to displace. It is, of course, the interest of old Officers to encourage "such notions, but, practically, they, the first recipients of such bonuses, are the "only persons who profit, all those who come after, being merely in the position of "recovering the sums they had previously spent in the subscription. I think every "possible official discouragement should be thrown on such schemes, while we "should not cease to suggest the expediency of enforcing retirement according to "certain scales of pay, rank, and age." The result would be, as it was in the Indian Army, to overburden the Officers with debt with no earthly advantage, because, as has been said, they only recover money which they had previously laid out, and the retirement would be just as quick if they kept their money in their pockets or invested it in the funds. Let officers retire according to their respective plans of life, and let the Government aid, by the grant of suitable retired allowances. I trust that you will pardon me for trespassing so long upon your attention.

Captain MITCHELL, R.M.: It is with diffidence that I venture, in the presence of so many my seniors, to make one or two remarks. With regard to the second suggestion of Colonel Robertson, the increase of educational qualifications in non-commissioned Officers recommended for promotion, it appears to me that at present the practical effects would be to select from non-Commissioned Officers those who are least fitted to command men. Everybody who has any experience in the service knows, that many young men of good education join the Army as a last resource, who are not the good soldiers that educated men are in other armies. If this suggestion of Colonel Robertson were carried out, they would be the very men who would take advantage of these educational qualifications; but of course there could be other tests. With regard to the French system of one-third choice and two-thirds seniority, I know that in that service it excites a great deal of bad feeling; although it is kept under by various means which we could not possibly employ in our service. I think the choice of Officers, even under the restrictions which Colonel Robertson has assigned to it, would be an exceedingly difficult thing, and an exceedingly invidious thing for any Officer to exercise. With regard to the qualifications for the promotion of Officers, three of the four qualifications given, are very good in themselves. There are, however, many very good Officers in the service who possibly could not come under any of those heads. It is not possible for everybody to perform "distinguished service in the field." There may be many very good subalterns in a regiment, and yet only one of them, probably, can have the opportunity of performing the duty of Adjutant. The Staff College is a thing that seems to me only available for the few, rather than for the many. I pass over the term that Colonel Robertson suggests a Colonel should be permitted to retain command of a regiment, and I come to the question of exchanges "permitted in all ranks." I do not know whether Colonel Robertson combines that with the system of selection for promotion above the rank of Captain. If he does not, I would suggest that it would be a very great hardship on an Officer who is second for field officer's rank, to allow an Officer who has just been promoted to the rank of captain, to exchange with the Officer who is senior in the regiment, and so pass over an Officer who is very much his senior. I have not touched on the purchase question as I belong to a non-purchase corps.

General Sir William Codrington, G.C.B.: There is no doubt that the questions that have been mooted are very important; and one result of the discussion on Colonel Robertson's plan, has been the introduction, by Sir Charles Trevelyan, of the great question of purchase or non-purchase. The great point in our Army as far as my experience goes, is the regimental system, namely, that an Officer entering a regiment, hopes to get to the command of that regiment by fair and direct promotion. If there is to be this selection spoken of, it will be a very difficult thing for any committee to decide about the comparative merits of the Officers of a regiment of which they form part. If I recollect right, on the question of selecting Commanding Officers, that is to say, from the rank of major, who was to be a Commanding Officer, the Commander-in-Chief himself, the Duke of Cambridge, declined being responsible for the selection of Officers for that post, from its being a very difficult thing for him to judge of. I think it would be a very difficult thing for Officers in a regiment to put their finger, not only upon the merits, but upon the demerits, that is to say the comparative demerits of other Officers, whom they reject for promotion by putting a junior Officer over their heads. That is one of the most difficult points. All Officers, I think, feel that it is the regimental system that has kept us very much together. An Officer enters a regiment, he feels while he is there, that it is his home: he hopes to get on to command a company; he hopes to get up to be major of that regiment; he hopes to command it; and in many cases to die in the regiment. Well, if there is to be this selection, this changing from one regiment to another by selection, I say it is a very difficult point, and one, I think, that will be scarcely practicable. And here comes the point: Look to the foundation of our English Officer, what is he? He belongs peculiarly to the class of the gentry of England. Independently of his position as an Officer, he is in social position, a gentleman. He is not only to be received in society as a gentleman, but by the Mutiny Act he is a gentleman; therefore, he can be called upon, either as a matter of social business, or as a matter of positive law, to act as a gentleman. Now, without going into the question of the comparative merits of private soldiers and non-Commissioned Officers, I put it clearly, is it not a very difficult thing for a private soldier, who must get to a certain length of service, and a certain rank by that service, before he becomes a commissioned Officer, to enter at once into the social position that is required by Act of Parliament, independently of the social feeling? That is the great difficulty which I think those ignore, who wish to introduce the middle classes of the country into a profession that is not remunerative in a money point of view, but which is partly so by honour, and the Officers of which should feel that it is better to be thus remunerated.

We must now come to consider what are the general motives which influence the classes whom it is sought to introduce into the Army as Commissioned Officers. First of all, we will begin with the private soldier. Why is it that we have lately received as many recruits as we want? Because we have increased the pay of the Army to a certain point, so as to induce them to come in. They find it is better worth their while; and we must feel that to a certain extent it is a question of payment. We will next take the non-Commissioned Officer. What is the inducement to the non-Commissioned Officer to enter the ranks as a private soldier, with the hope of becoming first a non-Commissioned, and then a Commissioned Officer? I will compare his position with other positions in life. It is perfectly true, as Sir Charles Trevelyan has said, that there has been an enormous advance made in the application of the talent of England,—to what? To the colonies, to engineering, and to all sorts of occupations giving great remuneration,—wide fields for employment and great remuneration. Now, a private soldier has 1*s.* 2*d.* a day; a corporal has 1*s.* 7*d.* Now I would just ask any one, taking the really talented class to which reference has been made, who can put their children as apprentices to engineering, or to the various other employments of life, whether they would be willing to come into the Army for the sake of 1*s.* 7*d.* a day to do the duties of corporal? What are the duties of the corporal and private soldier in our Army, of whom two-thirds are employed in the colonies? Mounting guard, cleaning belts, and other excessively irksome duties. What is the inducement for them to come? There is the real difficulty that I think Sir Charles Trevelyan has not seen, in a mercantile country like England, where there is an immense field for the working classes, both at home

and in the colonies. I do not see why those classes should come into the Army. Now as to the non-Commissioned Officer. He has come to be a corporal, a sergeant, and this after a certain term of service in which he has spent the best part of his life. Say he then becomes a Commissioned Officer. What is his pay? As ensign, it is £80 a-year, scarcely enough to pay for his positive expenses. How are we to suppose that a non-Commissioned Officer is then to enter really into the spirit of his new position in the Army? He may have married in a different class of life, and a thousand things of that kind may interfere socially with his position. I have known, and I will be bound to say that many Officers have known, non-Commissioned Officers who have come to be Sergeant-majors and then Officers, who have wished themselves non-Commissioned Officers again. Why? Because their half-pay was positively not so much as the pension they would have got; and they were put in that position in which they were obliged to be socially higher, and yet not able to support their rank. These are the practical difficulties which I think every Officer in the Army must feel. We now come to another point. The question of purchase which has been mentioned is a question upon which there is a great difference of opinion. Even those who have been non-purchasing Officers have felt that they have had very frequently great advantages from the rapid run of promotion that has taken place, bringing them up to the head of the list. Of that there is no doubt. We must also consider this, what is the class you want for Officers in England? The Officers of the English Army have now, from various causes, a certain feeling of independence. This may be occasionally inconvenient as to discipline, but it is of national value. Although in a separate profession, paid by the State, and whilst keeping themselves free from State politics or from State discussions, they feel that they need not give up that feeling of independence appertaining to the class of English gentry from which they spring. I look upon that, in a constitutional point of view, as a very great advantage to the country, to have the Officers of the Army in this position. These are things that are incidental to the position of the Officer, as a gentleman. It is a very great object, and it is valued by the men and the non-Commissioned Officers, that the Officers should come from that class, that you should be able to insist upon their being not only Officers, but gentlemen, to whom the men and non-Commissioned Officers can look up.

The CHAIRMAN: If no other gentleman has any observations to make, I will now call upon Colonel Robertson to favour us with a reply.

Colonel ROBERTSON: I would only say, in reply to Sir Charles Trevelyan, that in constructing my plan I mentioned that there was to be no increase of expense. Now, Sir Charles, I observe, takes it for granted that the country is prepared not only to pay a very large sum in the way of compensation, but to increase the pay of the Officers of the Army. If the Chancellor of the Exchequer were to put so large a sum at my disposal, I do not think I should adopt Sir Charles's scheme, nor should I adopt my own; my scheme, however, should be judged of as one that does not involve one shilling of expense. As to these exchanges which many gentlemen have objected to, I do not like them myself. If you can give unlimited retiring allowances and compulsory retirement you will secure promotion without exchanges. But I think that the system of exchanges is better than the system of purchase; I think they are objectionable, but as I do not think there is any chance of the Chancellor of the Exchequer giving retiring pensions to Officers of 15 or 20 years' service I must do the best I can. I think if you go into detail my proposals are not so objectionable as the present system. I do not think it a good thing to introduce a system of exchanges, but I adopt it as the less of two evils. Sir Charles stated very truly that the Army is composed of only two classes, the highest and the lowest. I think that is a very great advantage. Those are two classes of the population that you could not make any other good use of, whereas, if you succeeded in attracting the middle classes into the Army, why you take away men that make excellent engineers, and excellent men of commerce, and you would pay them highly, to do what? to clean belts and do duties that their talents would be thrown away upon; whereas, if you introduce the lowest class, you educate them and give them the opportunity of rising to a higher grade. You make many of them most useful, and many of them excellent members of society. I would say the same thing of the Officers;

the men who go into the Army make excellent Officers, many of them when put into positions of responsibility evince great talent; but if you exclude those men from the Army, or if you make the conditions such that they cannot enter, what will become of them? They will become useless, they will become idle. Under the existing system you utilize two classes that would otherwise be of little value to society. I have the pleasure of agreeing with Sir William Codrington in many things that he has said, especially in his estimate of the different kinds of motives which respectively induce privates, non-Commissioned Officers, and Officers to enter the Army. Allow me to say that in many of the propositions that I have made, I do not propose them as good in themselves, but as the best under the circumstances. You have a great evil, and how are you to get rid of it without money? Of course, if the Chancellor of the Exchequer will give me the money I should consider what to do with it, and I have no doubt it might be possible to devise better arrangements than those which I have proposed, and ventured to hope might be favourably considered, chiefly for this reason, that they could be carried out without adding a shilling to the Army estimates.

Mr. DYKE ACLAND, M.P.: I rise for the purpose of asking a question. I, as a civilian, came here for the purpose of hearing the opinions of military men on Colonel Robertson's paper. Now, I have had the advantage of hearing from the distinguished General on my left many of the current opinions of the Army. I hope it is no disrespect to him to say, though I feel the importance of them as a matter of military opinion, still they are not new, that they are really an answer to Sir Charles Trevelyan. What I do feel, as a civilian coming here for information, attracted by the programme of Colonel Robertson's paper is, that we have been discussing a speech from Sir Charles Trevelyan and not the paper of Colonel Robertson. I feel it is rather hard on Colonel Robertson, who has given a great deal of thought to a difficult subject, and one which we civilians are anxious to study. We want to know the opinions of military men. We also know that there will be at our backs a very strong public opinion in a different direction from the opinions of the Army. I do not pretend to form an opinion on Colonel Robertson's plan, but it does appear to me to deserve discussion. I, therefore, wish to ask whether a future day can be fixed for an adjourned discussion.

Sir W. CODRINGTON: The paper of Colonel Robertson is an important paper; but I must also say that I feel it a very difficult thing to come down here, and on an incidental discussion—for it was by accident that I came here—discuss papers that are written with great care and ability. The other question, that of purchase, was also brought forward very prominently, partly as an answer to Colonel Robertson's statements. It is one that has been discussed very fully, and with the utmost talent and the utmost perseverance, I mean the question of purchase; that is the only reason that I entered into the question.

Mr. DYKE ACLAND: I am afraid that I expressed myself in a manner which I should regret, having on private, as well as on public grounds, great respect for the gallant Officer, but what I wished to say was, that I was anxious to hear Colonel Robertson's paper discussed, but, instead of that, it seems to me that we have been discussing the speech of Sir Charles Trevelyan.

The CHAIRMAN: Before the meeting adjourns to such day as the Council may think proper, I should wish to make a few observations. Having been brought up in a seniority service, where retirement by purchase has been the rule, I look with great abhorrence upon the system of purchase, and I believe that is generally the view which is entertained now. But the point on which I would venture to make a remark, is in reference to the source from which the soldiers of our Army are drawn. The comparison which has been made between the armies of foreign countries and those of England is, that abroad the conscription is the source from which the Army is recruited; in England it is the voluntary system. I must say that my feelings are strongly in favour of the system which has prevailed in England for so many years, because I believe that as long as Englishmen are what they have been for centuries, loyal, devoted, and brave, they will be able to do what they have always done, *i.e.*, hold their own against all the world. I do not believe there is any army now in existence, which confronted with an equal number of British soldiers, would

be able to beat them. Therefore, although systems may be introduced, which have certain advantages over the present system—and Colonel Robertson's, which is the result of long years of thought and great study, and has been brought out in such detail, must necessarily be a useful basis in all future consideration of the subject—still I think that we may be proud of the Army as it has existed: it is a good Army, I believe a better Army than exists anywhere else. And if we look forward to have a better Army, it will hardly be from getting a better material than that of which it is now formed, but from better organization and arrangements in respect of the promotion of the Officers, rather than from an amalgamation of Officers and men as is partly suggested. I have no doubt that the paper which has been read, will add one to the many papers read in this Institution, which have been productive of very great results. I trust that I have the permission of the meeting to offer our best thanks to Colonel Robertson for his valuable paper.

Evening Meeting.

Monday, May 18, 1868.

VICE-ADMIRAL R. SPENCER ROBINSON, Controller of the Navy, in the Chair.

NAMES of MEMBERS who joined the Institution between the 11th and 18th of May, 1868.

ANNUAL.

Dixon, Manley C. M., Lt. 8th or King's Regt., 1*l.* Berkeley, H. F., Cornet 3rd Hussars., 1*l.* Biron, Thos. Viny, Lieut. 4th W. I. Regt., 1*l.*

THE NATIONAL DEFENCES OF GREAT BRITAIN, ESPECIALLY WITH REFERENCE TO THE FUTURE REQUIREMENT OF FLOATING FORTS.

By SAMUEL J. MACKIE, Assoc. Inst. C.E.

IT is impossible to over-estimate the value of a thorough and searching inquiry at this time into the whole question of our national defences, for just as the Navy has been passing through large and important changes, the series of which is not even yet completed, so land and shore defences, in other words, fortifications, are inevitably entering upon a like phase of total re-construction, and enormous waste of money cannot be avoided without free and acute public discussions are facilitated; in short, without a battle of argument and experimental practice. In such a controversy, however, no personal elements ought for one moment to be allowed to predominate, but the main effort should be directed to the attainment of the most accurate knowledge upon which to base the new theoretical projects to be carried into practical operation.

The object of this paper then, is very concise and very distinct. It is considered that the time has arrived when the provision of floating forts for our coast and harbour defences can no longer be disregarded with impunity, and that the safety of the maritime defence absolutely necessitates such auxiliary aid.

The consideration of this subject necessarily involves two separate investigations:—

First. A just estimation of the existing, as also of the prospective condition of our coast fortifications.

Secondly. Admitting the necessity for floating batteries, what is the best form of stable platform for ensuring accuracy of fire from the guns.

The first portion of the subject requires a general review of the condition and progress of our present fortifications, and of the system or systems upon which they are being carried out; and in connection with this an equally general consideration is required of the most important cases of attacks by iron-clad and steam ships, and of the defences made by littoral fortifications since the period of the general introduction of rifled guns and iron armour into the great Navies of our own and foreign powers.

As to the enormous fortifications of our arsenals and dockyards which are proceeding, there can be no doubt that a system which is two hundred years old, cannot be properly suitable for the national requirements at this date. What is called the "modern" system of fortification, is primarily based upon that of Vauban; and even this so-called "modern" system is of far too great age to be appropriate to the necessities induced by rifled and heavy ordnance. One of the main defects of Vauban's system, in all its modifications, and against which those modifications have incessantly struggled, has been that of enfilade, which the power and range of modern artillery has so greatly, almost insuperably increased, whilst the strength of most works has been mainly estimated against attacks by guns of not greater power than our late 68-pounder smooth-bores of cast-iron. The strength required in the parapets for secure protection against modern heavy guns would now involve masses of earth of most inconvenient thickness. The 68-pounder, with 16 lbs. of powder, and the 7-inch breech-loader rifled gun, with 12 lb. charges, will, at a thousand yards range, pierce a parapet of very compact loam of 22 feet in thickness. Our present 9-inch rifled gun has, I believe, completely riddled 44 feet of solid clay. It is evident, therefore, that earthworks of appropriate dimensions against such arms, must involve openings for the defensive fire, such as not only to cause inconvenience and danger in the working of the guns, but also seriously to weaken the line of defence itself.

Another and very great difficulty is incurred in modern fortifications in providing traverses to stop the ricochet of enfilade fire.

Masonry also, we know suffers from modern rifled and heavy guns in similarly increased proportion, and while at 200 yards the old 24-pounder iron shot penetrated into good masonry not more than 20 inches, modern rifled guns will send their cylindrical bolts into solid granite work a distance of more than 14 feet. Even the Armstrong 12-pounder is capable, at 70 yards, of penetrating 33 inches of brickwork laid in cement, and the 80-pounder polygroove rifle, with a 10 lb. charge, sent its shot completely through the wall of the martello tower at Eastbourne, 7 feet 6 inches in thickness, at over 1,000 yards range.

Almost at the dawn of the coming general use of rifled guns, the necessity for which was prominently brought out during the Crimean war, the inadequacy of the existing systems was perceived and commented upon by eminent artillerists and engineers, and most competent men would now be thoroughly agreed, that the modern revolution in arms has entirely changed the data upon which fortifications ought to be designed and erected. That no proper system, adapted to modern requirements, has yet been devised, the state of our published literature will, I think, sufficiently pourtray. Our present forts and fortifications show but too practically the confusion of ideas and ignorance of special requirements which prevail, by their different developments, at different places, upon all sorts of theories, without any reliable bases having been officially laid down. A high authority, the late Professor of Fortifications at Addiscombe, distinctly asserted in 1860, when the development of the manufacture of heavy ordnance had attained to nothing like the rank it now possesses, that there could be little doubt that with rifled guns of such accuracy and range as were then coming rapidly into use, enfilade would be practised with a precision, and from a distance vastly greater than had hitherto been attempted, and it would be a question, he thought, whether any gun on an open rampart would remain undisabled for a day. This being the case, there can be no doubt but that all guns of fortresses must, sooner or later, be placed in casemates, where they are entirely secure.

It is no part, however, of my present project to discuss the difficulties of modern land fortifications, nor to advocate any novel or future system in respect to them. It is quite clear that the range of modern artillery must necessitate the most extensive and formidable works upon the land side of any arsenal or dockyard where the primary object is to protect a large quantity of useful or necessary stores from destruction. Two important systems for such purposes seem to be looming in the future, one in massive lines of lengthy earthworks, defended at intervals by iron casemates or turrets; the other a series of potted guns in holes sunk below the soil, or, far more useful, if an admirable invention be employed, long lines of earthen parapets with railways behind them, from which the heavy guns might be, by mechanical means, raised above the surface, as by Moncrieff's carriages, simply for the act of firing alone, and which, in the latter case, being constantly moved about, could not only follow the motion of troops or ships, but, never remaining in the same place, would keep the enemy in ignorance of their whereabouts. But whatever future system may arise, or whatever combination of existing or coming plans may be hereafter adopted, the future of land fortifications will not be a series of problems how most securely to shut up bodies of men within lines of impenetrable obstacles, but rather the preparation and disposition, in peaceful years, of impregnable fortresses, to form "prepared battle-fields, where the defenders, if inferior in numbers or morale can fight with the greatest advantage under the support of a powerful artillery;" the outworks of the active defence being constructed to allow a whole army, with cavalry and field artillery, to issue forth suddenly from under cover, and to retire with equal facility.

It is in this view of large entrenched camps that the extensive land-works round our naval arsenals, will find their best excuse, whatever opinions may be entertained of the effectiveness or economy of their construction.

It is, however, solely in respect to the shore defences that we have to deal in this paper. The main questions involved are—

First. The direct attack of the port, with a view to its capture.

Secondly. The possibility of a distant bombardment with effect from the sea; and

Thirdly. A sudden raid attempted by ships for a destructive purpose.

The complete capture of an important naval station would necessitate a regular approach, both by sea and land, and could scarcely happen while the British Navy maintained the supremacy upon the sea, or even existed as a powerful force. But such attacks might arise if the English fleet were badly beaten by a foreign foe, or were exceeded in power by the combination of the navies of several foreign States. Sudden naval raids, with a view to perform as much destruction of stores and *matériel* as could within a brief period be effected, are very likely to be frequently attempted in any future wars, and it is mainly against operations which may be accomplished within a period of one or two days that we think it is most important to be guarded; and bearing in mind that bombardments at very long ranges of four or five miles could be performed by the aid of accurate charts, by ships taking proper bearings, with high chances of great destruction in places of large extent, it seems desirable that where enormous shore and strand spaces exist, as at Plymouth and Portsmouth, the factories and stores should be as widely distributed as possible with convenience to the work to be performed. Certain it is, that considering the power of modern armaments, provision for a successful defence must be made during a time of peace, and cannot be effected without enormous outlay of money. Personally, I think that these outlays should be regulated by the condition of the labour market, and that, if executed at a greater rate during periods of commercial distress, they would mitigate the sufferings of the working classes, at the same time that in reducing the poor rates, they would utilize and make properly beneficial the contributions which at such periods are inevitably exacted from the rich and middle classes, either in the shape of voluntary charity or direct taxation.

In estimating the value of our present defences, and in contemplating what ought to be the future direction in which such defences should be mainly developed, it is of the utmost importance to digest the knowledge obtainable from the important operations in the great American war, for the details of those hostilities not only show us the highest development of the old systems of fortifications, in every condition and circumstance of modern needs, but also give us the best information as to the powers of attack by modern rifled and smooth-bore heavy ordnance, as well as of the capabilities of modern iron-clad ships. The main details of the most important cases are exceedingly well given, from official documents, in Lieutenant-Colonel von Scheliha's recent

treatise on "Coast Defence." I think the main results may be very briefly epitomised in these propositions:—

1. That in all cases the American steam-ships, iron-clad as well as unarmoured, were able to pass fixed shore forts, without receiving any seriously damaging injuries. This happened at Mobile, at Forts Jackson and St. Philip.

2. That strand forts, and other low-lying batteries placed near the sea, were always to be silenced by the concentrated fire of the ships. As at Fort Fisher.

3. That where the guns were placed high, say at elevations of from 100 to 300 feet, and separately or in small groups at considerable intervals, the plunging fire was found to be exceedingly distressing to the ships, but which nevertheless were able to pass and repass the forts, subject to considerable danger. The batteries at Vicksburg were of this class.

4. That in all cases,—and this is the most important condition in connection with the present paper,—in all cases *where the ships could be detained by either permanent or floating obstructions under the fire of the shore forts, they were prevented from passing* and attacking more important in-shore stations. This last condition is most prominently illustrated by the affair at Charleston, in 1863.

The position of Fort Sumter, the disposition of the five main forts at Spithead, and the great iron-clad fort behind the Plymouth Breakwater, are practical illustrations of the opinions alike of English and American engineers as to the necessity of having powerful batteries in artificial positions in the sea, the fire from the natural positions on the shore not being equal to control the entire area of the waterway for ships. It is perfectly obvious, then, in considering the future requirements of floating forts as auxiliary to coast defences, that while forts on the shore can only be erected upon the best natural sites, the forts in the sea can be put in the best and most effective places possible. In respect to such artificial sea forts there are, one inherent difficulty, and two inherent objections. The difficulty in mid-sea forts is the obtaining of a proper foundation for the superstructure, and one objection also is of an engineering character, namely, that such forts when successfully erected, may become permanent impediments to free and safe navigation. The other objection is, as in fixed shore forts, that vessels moving at any given speed, can pass out of range of fire in a given period of time; their danger, therefore, of being struck will be in direct proportion to the number of guns employed against them. If the guns be concentrated in one large fort, the chances of the ship being hit will be in proportion to the area of waterway covered by the land fire. If the guns are isolated at distances along the shore, the chances of the vessel being hit will be in proportion to the number of guns, and directly also to the skill of the artillerymen, by whom they are worked. In either case, unless the number of guns be infinite, the period of time required to run the gauntlet of the batteries is definite, and open to previous calculation.

The four great advantages claimable for floating forts are:—

1. That they can take up any position required.

2. That in doing so, they are entirely independent of any engineering requirements or cost of permanent foundations.

3. That they form no permanent obstruction to any commercial or naval waterway, and can, in time of peace, be removed to stations and shelters completely out of interference with any sea-going or harbour approaching tracks.

4. That under the defence of floating batteries there is afforded a direct way of barring the entrance to any port or river, and of arresting the progress of any naval hostile force, at least temporarily, and by proper provision, completely, under the close and searching fire of the floating forts themselves.

5. That by their use, the greatest economy of guns and men can be effected without detriment to the defence.

6. That being free to be moved to any station required, the fire of the floating forts will be available for any required operation so long as the fort and its armament remain not seriously injured.

7. That such floating forts can be made of superior impregnability as well as stability to the most formidable and best designed iron-clad ships.

Upon the first and sixth points no one can dispute the advantages, nor do I think that if a reasonable amount of satisfaction and confidence could be placed in the fort as to its entire impregnability to any anticipated and serious bombardment, and in its capacity for floating even after very considerable damage had been inflicted upon it, that there would be any *à priori* lack of preference for floating over permanent in water fortresses.

Upon the third point it is evident that in many situations a fixed water battery would be of vast value as a measure of defence, if commercial reasons and the necessities of navigation did not forbid its erection. Take, for example, the present undefended state of the Thames, and see of what undeniable and vital importance a mid-channel fort in the river below Tilbury and Gravesend, or between the Corringham and Cliffe Marshes, would be for the protection of London, the enormous number of ships in the pool and surrounding docks, and the almost inestimable stores of goods and merchandize in the miles of concurrent warehouses. A floating fort, even without motive power, so stationed, would be equally as valuable as a fixed one as a means of defence, and could even in time of war, except at the period of actual attack, be moved out of the way of mercantile traffic. In time of peace it might be utilized as a light-ship on the Blygh Sand or at the Nore, or turned to any other useful or economic purpose.

The question of cost of iron-clad floating batteries is one that can hardly be a barrier to their employment when it is proposed to use iron in enormous quantities in the shore defences. Rolled plates of any thickness, light or heavy, will not cost more to manufacture whether placed on the land or floated on the sea, whilst the expense of obtaining floating capacity over a small area on the free water will not in any probability exceed the cost of obtaining extensive areas of valuable land for the shore fort, its approaches, glacis, and necessary surroundings of free and uninterrupted space.

Before approaching the fourth consideration it is requisite to take a brief view of the present and prospective systems of fortifying a large harbour, bay, or inlet, by means of land forts disposed around its shore. The number of guns disposed in the forts at present erected or erecting around Plymouth Sound, is no fewer than 128, namely:—Staddon Point 22, the Breakwater Fort 22, Picklecombe 42, Cawsand 10, Mount Edgecombe 7, West and East Kings 15, Hooe 10, Staddon Heights 34, without reckoning those in Knatterbury and Polhawn, the four Redoubts on Maker Heights, Wilderness Point, Stonehouse Fort, Citadel, Staddon Battery, Brownhill Battery, Staddon Keep, and the two redoubts protecting Milbrook Lake. In addition to these, the waterway is obstructed by the enormous erection of a breakwater of a mile in length, fifty feet broad at its summit, and erected out of deep water varying at neap tides from four to eight fathoms. Behind this rises also out of deep water the masonry foundation of a huge oval iron fort 180 feet on its major axis, now forging at the Millwall Works. This Plymouth breakwater fort is to contain 18 heavy guns. Adverse opinions as to its powers of endurance have been very strongly expressed, but it is neither convenient nor desirable to discuss in this essay its mechanical construction or powers of resistance to the penetration of the guns which may be brought against it. As designed and manufactured it is an open structure, and therefore must be, as a military work, under such circumstances liable to be silenced by a distant shell fire from a sufficiently powerful fleet. If silenced and captured, it could, with any use that could be made of the breakwater itself, be employed as an established point for a new attack upon Drake's Island higher up the Sound, where 35 additional guns are planted, supposing, of course, that the forts at Staddon and Picklecombe had been equally silenced by the enemy's fire. It seems possible thus that a powerful and daring foe might, notwithstanding the present provision of defence, at least perform the like serious sudden and damaging naval operations which were so successfully and continually carried out by those able United States' commanders, Admirals Farragut and Porter. The idea of barring the channels between Picklecombe Point and the west end of the breakwater, and Staddon Point and the east end of the breakwater, by permanent obstructions over the whole, or any considerable portion, of their width, such as was done at Charleston between Fort Sumter and the shore, could never be for a moment entertained in respect to so important a naval station as Plymouth. In war, or in peace, the largest ships of the Navy must at all times have free access to the inner Sound and Hamoaze. The extent of the rise of the tides in the English Channel would also be exceedingly adverse to their employment, as well as to their effectiveness. As Plymouth is at present mainly defended by the three forts in connection with the breakwater, I cannot but think that the fire from them must be too limited to prevent a fleet of any considerable number of vessels from running the gauntlet of those forts with less loss than would materially affect their hostile operations. It would seem, however, that by proper iron protections for the artillery of Picklecombe and Staddon Forts, with auxiliary aid

from two or three floating batteries moored at intervals across the channels, in conjunction with a proper system of heavy chains and floating booms, the Inner Sound might be effectually barred to the most daring naval enemy, and his ships either sunk or put *hors de combat* by a concentrated fire before he could retract his efforts and extract his ships from the dilemma in which they would thus be placed. And here I would make a suggestion whether, by means of some such disposition of heavy chains and booms carried direct across the mouth of the Sound from Penlee to Reny Point, a more effectual defence of the Sound might not have been made than by the 25 land-forts and all their subsidiary erections and their isolated details of heavy guns, every one of which is liable to be silenced in succession by the fire of an adverse fleet. It is inherent in the nature of ships, and floating forts, that fleets of them can be made movable concentrations of force; the defensive system of shore batteries, on the contrary, is distributive invariably under all circumstances. If certainty of obstruction were more esteemed than money expenditure, gigantic floating booms (say 20 feet or more square, and 400 yards in length), in the practical form of iron floating quays, built in water-tight compartments, would present an impenetrable barrier, and would form, in their character of breakwaters, tranquil harbours of the largest extent, and of the utmost value as refuges in stormy weather. Harbours so formed by floating quays would have no tendency to silt up, which is always the case with permanent erections built up from the sea-bottom, and would be the most valuable and economic of any that could be constructed. The very different properties of bitumen and of zinc-sheathing, permit iron to be used in salt water with every advantage. In many cases, therefore, it may be observed that the construction of such works would, in the tranquil times of peace, be profitable and advantageous as commercial undertakings.

Certainly, if any plan of direct barring the water-way be admitted to be advisable, it includes a consideration of the most important character, namely, the capacity of doing more certain destructive work with a few guns than could be accomplished by the land forts with an enormous plant of artillery. Fifty-six guns so disposed at Plymouth would suffice to do much more than the utmost work that, under the most favourable circumstances, could hope to be obtained from the four times that number now placed at intervals around the Sound. Even if such a sea barrier line were broken through, or if even no intermediate obstruction were attempted, a naval enemy could not pass a line of floating forts without the certainty that they would follow him up and attack him in the rear whilst he was operating against the land batteries of the arsenal in his front—a position between two hostile fires which no prudent commander would permit himself to be entrapped into. It is evident that Portsmouth might be efficiently defended by such a cordon of floating batteries, and certainly such structures would be most advantageous auxiliaries to any forts commanding the passage of the Needles. Floating forts taking up positions in deep water channels would drive the enemy's ships towards shoal water, and any accidental grounding would be for them

irretrievable disaster. These sketches are only submitted as suggestions.

This question of the economy of heavy guns has also another and very important phase. More than 2,500 rifled guns of 9 inches bore and upwards, are alone required for the works actually in progress and approaching completion. The national stock is, all told, 265. It takes six months to make one of these heavy guns, and the Royal Arsenal at Woolwich is not equal to turning out more than 40 per annum. It will take, therefore, at this rate, 55 years to man those forts which, according to present rate of progress, we may expect to see in a condition absolutely requiring defence by the end of 1870. Nothing stronger upon the prudence of economy need be said; nor can there be any more forcible proof of the urgent necessity that exists for immediate activity in the production of the first most important instruments of warfare. The greater endurance and comparative cheapness of heavy smooth-bore guns should be regarded in our future manufacture of artillery, and in our present justifiable pride of the magnificent weapons which are now being produced in this country, it should not be forgotten that the ponderous blows of 400, 600, and 1,020-pounder spherical shot will have their special uses, not served by rifle projectiles, and that for straightness and length of range after ricochet, round shot are more to be depended upon than cylindrical bolts. The effort to obtain substantial breech-loading artillery should not be abandoned; the manufacture of wrought-iron mortars should also have attention.

In considering the means of defence for our great naval stations, I desire in no way to overlook or to slight the valuable powers of mortars and torpedoes. Nor do I think that in criticising the designs of the fortification engineerings which for the past eight years have been going on at Portsmouth, Plymouth, Pembroke, Portland, Chatham, Dover, and Cork, this fact should be omitted in any estimate of the propriety of those works at the time they were instituted, that in 1860 when the £11,000,000 was granted by Parliament, at Lord Palmerston's instigation, artillerists and engineers were looking, and the public were doing the same, at the enormous ranges of rifled guns. We have now arrived at quite another aspect, and the question that has come to be mainly regarded is, penetration. It is felt that very long ranges are impracticable for useful or certain results, and that guns may throw projectiles far beyond the visual power of the eye to direct their operation. The most effective defence from the shore will probably be the covering, by previous study and concentrated armaments, of certain areas of the water-way with a shower of missiles; and for this end, bouquets of large mortars, placed in suitable positions to control with a vertical fire the most important navigable channels, and discharged by correspondence signals, like the torpedoes, when the vessels are sighted within the doomed arenas, will be most valuable adjuncts to the careful aim of the rifled ordnance. Heavy guns, placed in isolated iron turrets, defended from *coup de main* by surrounding ditches, would, in many cases, be preferable, I think, to concentrations of ponderous artillery in large open forts. In no case, however, where

the water-way is of any considerable breadth or superficial extent, do I believe it can be effectually controlled by shore batteries obliged to fire at long ranges. Wherever the extent of water area is large, floating forts are, in my estimation, essential requirements, not only as artillery aids to the land forts, but also for the protection of the submerged lines of torpedoes.

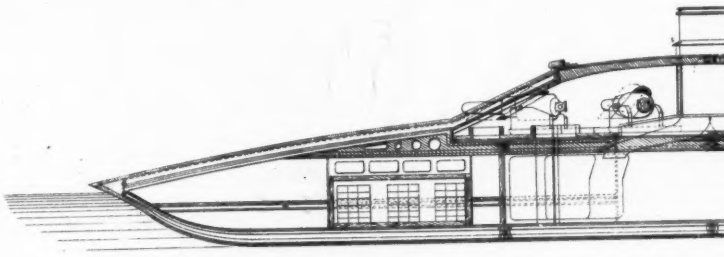
Brief as has been unavoidably this summary of the main points of one of the two important subjects included in this paper, the remaining time allotted to me must be devoted to the consideration of the best kind of floating fort; and in doing so, I shall avoid altogether questions of what could be or might be invented, and deal simply with that which I consider is the best plan proposed up to the present time.

Primarily a floating fort ought to be an entirely different structure from a sea-going ship. A ship is built upon lines suited for the attainment of the greatest speed, and adapted to make the vessel rapidly accord with the ever-varying motion of the waves and wind. Liveliness therefore is a first essential in a ship. The first essential in a floating fort, is stability of platform. The conditions of the two are therefore entirely opposed. Speed is not an essential for the fort, but ease and certainty of mooring is a necessary qualification. The properties therefore of ships and floating forts are also different; a ship rolls from one side to the other, and is designed of considerable draught of water, in order that her depth may keep her close in sailing to the wind, and prevent her drifting to leeward; also that her weights being low, she shall maintain a vertical position, her masts and sails springing back to the breeze at every modulation. It is also necessary to her easy passage through the water that she should rise to the waves while cutting through them, and hence the incessant longitudinal, as well as lateral oscillations. The pitch and scend of a vessel brings an enormous nip upon the cables at the hawseholes, and ships, as is well known, are exceedingly liable in stormy weather to part from their anchors. The lateral roll, which is particularly heavy, and must be so in iron-clad ships, renders such vessels all but useless, except in comparatively calm weather, as with a movement of above a few degrees, the port-holes would be liable to plunge under water at the same time that the difficulty of taking accurate aim is rendered very great indeed, if it is not altogether impracticable.

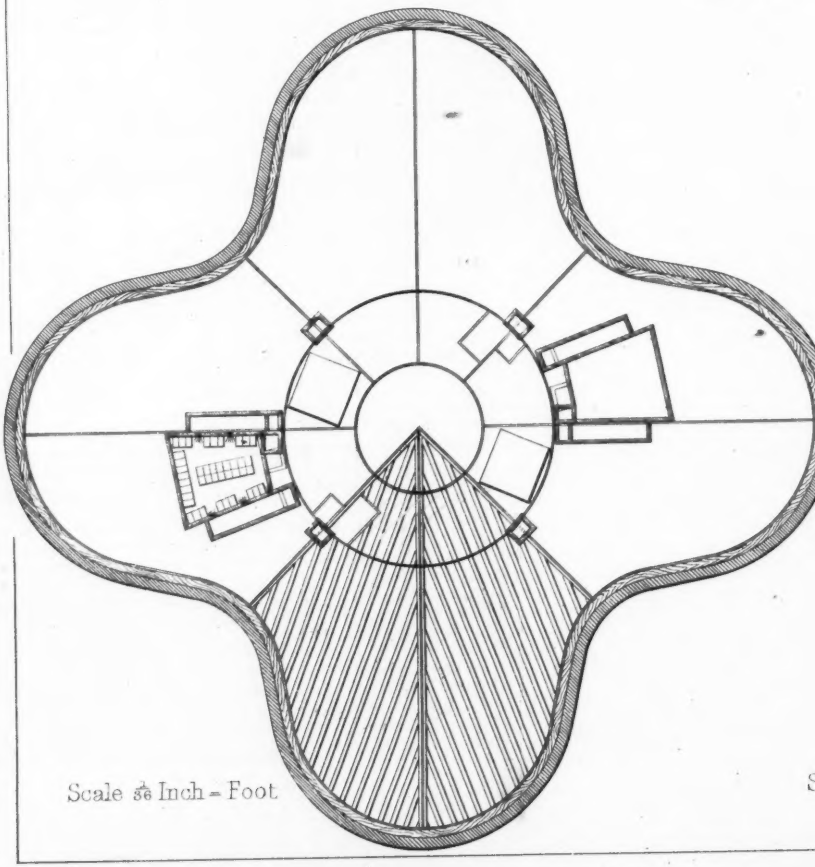
In the first place, however, a distinct objection should be made to the sole employment for harbour defence of old and inefficient ships converted, as it would seem, must necessarily follow, into inefficient floating batteries, because such converted vessels cannot be expected successfully to oppose in vital positions strong and properly constructed ships, for if vessels of the same class be opposed to each other, the strongest and best must have the advantage in the hostilities. It is also I think unwise and injudicious to build ships specially for harbour and shore defence, because ships are not the best form of construction, and ships will always be liable to be taken from their stations, and sent upon foreign expeditions. The floating fort on the contrary as advocated in this paper, is regarded as a constituent item in the defence of the place itself, and not to be with-

drawn from that duty, although it might be capable of performing an operation upon a foreign shore. Neither do I restrict myself to one exact type of floating fort, being open to the conviction that each particular place will require particular modifications of any system or systems which may be adopted. I think, however, that the primary consideration of stability of platform has found practical expression in the four rayed floating forts invented by Mr. Moody (Plate x), a gentleman who has had long and most extensive nautical experience. I claim, however, nothing more for his system than the utility of the platform itself, the increased power of defence afforded by the capacity of inclining the armour at any required angle intermediate between verticality and horizontality, the directness of the flotation, the light draught of water, and finally the capacity of being safely moored from under the centre and from beneath the floating structure. Of course it is impossible with so novel a design, to say absolutely what will be the actual capacities of speed in proportion to required steam power, if the fort be provided with a means of locomotion, or to state exactly how much battering from artillery and ramming from ships such a formidable floating structure would endure, but this much is certain, that a floating fort cuirassed all over with armour of from nine inches to six inches in thickness, supported upon suitably strong backing, must be more safe from vertical fire than are the decks of the most powerful iron-clad ships of this age; whilst against horizontal fire the practical strength of the inclined armour of the fort will be as superior to the same armour bolted vertically on the side of a ship as the angle of inclination is greater to the line of fire than a right angle, whilst it will also have the additional advantage of the probable, almost certain, glancing of the shots from its surface, and the impossibility of any attempt at boarding being successful. These conditions in the Moody Fort satisfy our seventh proposition, that the floating fort should be stronger with equal thickness of armour than the attacking ship.

With respect to the details and cost of floating forts on this system, I will only allude to the preliminary plans exhibited for a floating fort of 180 feet extreme diameter from the end of one ray to the end of the other, and an external diameter of the central cone of 114 feet, designed to carry eight 600-pounders, and intended to be propelled upon the hydraulic principle, with engines of 200 nominal horse-power. The inside diameter of the main gun-deck is 74 feet 4 inches, and the height between decks 10 feet 10 inches, the depth of hold, below the gun deck, is 12 feet 3 inches, and the draught of water of the fort is 8 feet 4 inches, the displacement calculated for this draught being 3,327 tons. The circle of guns has a radius of 30 feet from the centre of the battery; this dimension being taken on the principle that 30 feet from the axis of pitch and scend of a ship is the limit of best stability for the turrets on a two-turretted sea-going ship, and the length of the rays was adopted under the idea that it would be sufficient to take a bearing upon three ordinary waves. The models and drawings as exhibited, were got out under the direction of Mr. Moody himself, by a competent naval architect, who has estimated the cost at about £80,000. There are obviously matters of detail in this model and



Scale $\frac{1}{24}$ Inch



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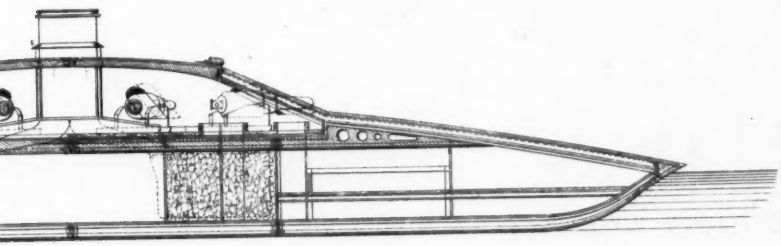
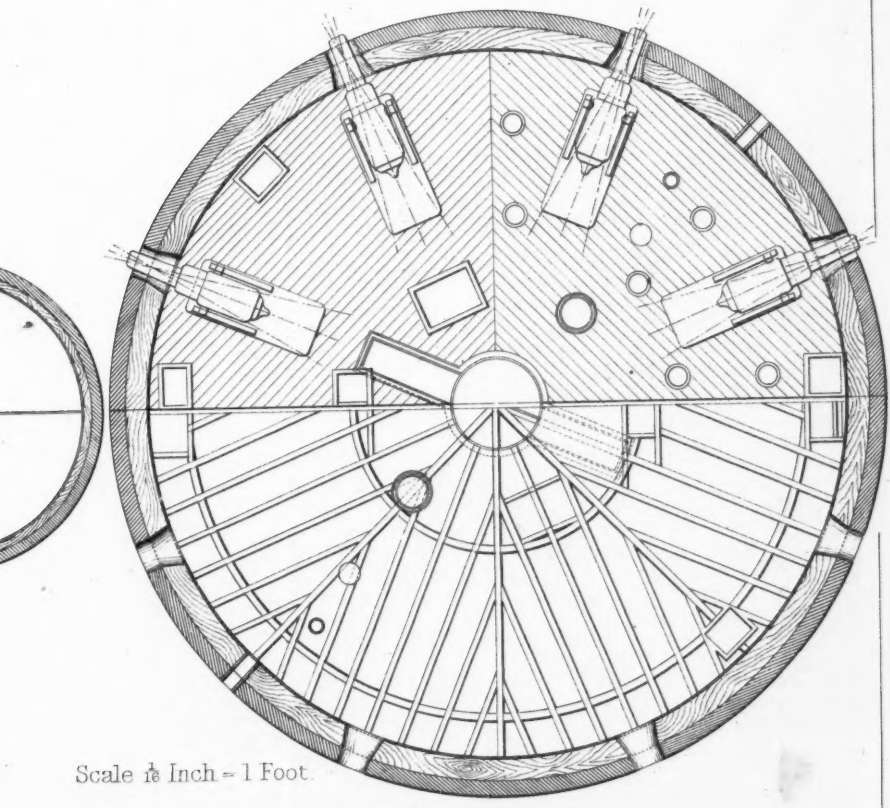


e $\frac{1}{24}$ Inch = 1 Foot.



Scale $\frac{1}{16}$ Inch = 1 Foot.

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the accompanying drawings, which require considerable modification, and I may say that I have personally considered many considerable improvements which would render the fort far more formidable than even it appears at present. The naval architect has estimated the speed, with the horse-power referred to, at from 8 to 9 knots an hour. Mr. Ruthven considers 6 knots as more likely; an opinion in which I concur, on account of the great flotation-power which has been given to this design, a power which could be vastly increased at a very insignificant cost, but with a largely increased disproportion of speed. The coal supply is estimated at a consumption of 30 tons per day of 24 hours to suffice for 8 days' full steaming. In respect to speed, however, if such batteries were directed to be built for foreign operations, I feel confident that by an alteration of the lines of the hull, the rate of from 12 to 14 knots might be successfully attained from the modified form. The model of Mr. Moody's lifeboat shows that it is possible to modify his ray-system into effective gun-boats.

Of course to any floating structure the objection may always be raised that it is liable to be sunk. The model exhibited is divided into nine main water-tight segments, namely, a central circular hold, and eight divergent compartments; and it is clear that as many subsidiary bulkheads could be inserted as might be desired. The fort, moreover, if constructed of the strength proposed, is invulnerable to all existing guns, and could be easily rendered, if required, absolutely invulnerable to still heavier ordnance by many auxiliary means well known to seamen and artillerists. The danger, therefore, of the fort being sunk is so remote, that we need not dread that catastrophe. Even under such a contingency, its light draught of water would permit the fort to settle into a fixed position on some shoal, or on the shallow strand, where the deep draught ships could not pursue it. Under such circumstances, in 2½ fathoms water, the fort could continue its fire. I believe I could so construct the central battery that the fire of all the guns, or any required proportions of the armament could be directed from any one side, so as to meet the attack upon any point with the full effect of the defending ordnance.

The power of rotating the fort is valuable too under some conditions in training the guns easily and successively, but the advantage is very great of being able under other circumstances to turn a wounded side away from the enemy in action, and to continue the fight with the guns of the undamaged portion.

Into further minute details either of construction or application of the floating fort, I am not at present disposed to enter, preferring to leave, as much as possible, free scope for modification to the circumstances of every case, and the wants and wishes of the constructive or executive Officers concerned in the direction and command of our national defences, if the Government should think fit to adopt or recognize this, as I consider, valuable invention. I desire only to bring on this occasion the main primary topics under the discussion of this able and practical meeting.

Admiral HALSTED: I should like to ask whether the summit of the floating fort

is flat and open, as we see it in the model, or whether there is any attempt to deflect the shot from a plunging fire?

Mr. MACKIE: I think myself that the flat top is the most effective against plunging fire, on account of the angle at which the shot strikes. But I do not think Captain Moody cares whether the top is made of a dome shape, or flat, or whether it is entirely covered with armour, or whether it is covered with grating. The main point considered by him is the stability of the platform. But with regard to details of that kind, the plan is open to the consideration of practical Officers.

Admiral COLLINSON, C.B.: How are you going to steer the floating fort?

Mr. MACKIE: The proposition is to use hydraulic power, and to have in appropriate positions, large powers of directing the structure astern or ahead, or for the purpose of rotating it. I think there will be no difficulty in applying water power. One great advantage which this fort will have over a ship is, that you will be able to work your engines at lower speed, which will be a considerable speed.

Admiral COLLINSON: How do you propose to anchor the fort?

Mr. MACKIE: It is proposed to anchor it from below. Whether you put anything outside to catch the anchor, or whether you have a space underneath for the anchor to go into, is a point rather for seamen to decide. But I do not think with regard to anchoring, that there will be any difficulty; but whatever difficulty there might be, I think it ought to be got over on account of the value of being able to anchor from below, and of not being obliged to depend upon line and chains. You can always get your anchor fixed with nothing more than a hawse-hole.

Admiral COLLINSON: I cannot possibly see how you are going to anchor a vessel of that kind.

A MEMBER: The difficulty would be to get the anchor up.

Mr. MACKIE: I would prefer that some nautical Officer should help me out of such dilemmas, because naval men have much more practical knowledge on these points than I can have. Captain Moody is present, but I do not know whether he will be disposed to speak, as I am sorry to say that he is suffering from the effects of a railway accident.

Admiral HALSTED: Has it been at all contemplated to moor, or anchor the vessel from the centre of gravity entirely, like the proposed mooring of Mr. Herbert's floating fort?

Mr. MACKIE: That was a circular fort.

Admiral HALSTED: A circular fort, and of a different form from yours.

Mr. MACKIE: Of course, if you can moor a circular fort from the centre of gravity, you can moor this in the same way; because if you extend these central lines, the figure becomes that of a circle. But the disadvantage of the circle is that it is more liable to roll than this.

Admiral HALSTED: Are you sure of that?

Mr. MACKIE: I think so. You will also find this, that a circular fort is more likely to subside into the trough of the sea than this is. I would rather not speak against any other plan; I merely suggest the advantages of this.

Admiral HALSTED: Do you propose that forts on this plan shall be sea-going vessels in any practical sense of the word, so as to be able to pass from point to point along the coast?

Mr. MACKIE: Such a fort as this, is distinctly not a sea-going ship; but if you want to make it sea-going, you have only to remove two of the rays, and it will then assume something of the form of an ordinary vessel. This plan can be modified for any purpose.

Mr. J. M. HYDE: It might be interesting to the meeting to know that designs for ships of that description have been for many years submitted to the various authorities of this country. You see the system of ricochet has been adopted in this design (showing a design).

Mr. MACKIE: For floating forts?

Mr. HYDE: Yes, these ten years. This is the form of a ship that has been submitted for that particular purpose. You notice the angle, both above and below the water, is 22½ degrees. It will be interesting to the meeting to know that the ricochet, or process of deflecting a shot, has been known for a very long time.

Mr. MACKIE: I no not claim that as a principle.

Mr. HYDE: But some gentleman has asked how a vessel of that kind is to be navigated. I say that a design has been submitted for navigating a ship that may be called a fort as well as a ship.

Admiral SIR EDWARD BELCHER, K.C.B.: I see every facility on that floating battery for pursuing the mode of attack which I have generally advocated, and that is the running-down system. That vessel is of 2,000 tons. The "Warrior" is of 9,000 tons. If the "Warrior" rammed at one end, or the segment of the circular form of that, she would cant it in a moment, and it would go down. There is a second difficulty. I do not see how, unless we entirely adopt the hydraulic principle, and it must be adopted also for steerage, how that fort is to be steered about, or how we are to get any velocity out of it to annoy an enemy. Now, the great advantage which I see in that fort, if it is to be made use of at all, is that in the event of an enemy passing up a channel, you may ground it, and make use of it as a grounded battery. In that sense it may be a formidable obstacle in the way; but as far as attacking is concerned, if you have two ships that are determined to take that fort, they have only to pass a chain between the two of them, swing alongside of it, and they will fire down into her decks, and destroy her in two seconds. And with the dimensions which have been given, and with the iron that would be employed to construct that vessel, I maintain that the guns would be very nearly at the water's edge, from the weight of iron alone that would be required to protect it. Or, supposing you took two merchant vessels, and put spars between them, and let them drive with the tide over it, you would completely overwhelm its guns and prevent their being fired at all, while your own vessel passed on and attacked any other forts up the harbour. So far as motion goes, the inventor of the hydraulic system, Mr. Ruthven, has supposed that he would get six knots out of it. Now, I should like Mr. Ruthven to say positively, for he can tell you to the decimal part of a rule, and I see he is sitting there, what is the actual speed that you can possibly get out of that vessel. If that battery has not speed sufficient to run away from a ship that is inclined to run over it, it is absolutely useless.

Captain MOODY: I should like to be allowed to give a little explanation with reference to this battery, in the way of steering or managing it. There will be an outlet of water or sluice, after my principle, by the side of every arm, making eight outlets, so that by working the valves, opening this valve and that valve, you propel the vessel in one direction; if you wish the vessel to go the other way, you open the other two opposite valves, and you propel the vessel in the other direction. So that you can propel the vessel whichever way you like; or if you open one valve, and then another on the opposite arm, you cause the vessel to revolve; or, again, if you wish it to revolve the other way, you have only, as it were, to open the two opposite sluices, and the vessel turns round the other way. Now, in regard to the mooring of the vessel, I should state that the mooring of the vessel comes out at the inward curve there, on two opposite sides of the vessel were a moving crane, or a moving cathead, by which you throw those anchors out, so that they would drop down clear of the vessel, and the chain attached to the anchor would come out below. The vessel, I am confident, would ride with all ease imaginable. As to other vessels coming and covering this battery, so that its guns could not be fired, I cannot conceive how such a thing could possibly take place. You might bring a vessel in the way of those guns, but how to cover and to prevent those guns from being fired into that vessel, I cannot conceive. That is, I do not see it. As for the open space at the top, I think that a grating of sufficient strength would answer two purposes. It would answer for ventilation, and also for protection against shells; that is, it should be made sufficiently strong for that purpose. With reference to the design (Mr. Hyde's) that has just been brought to your notice, I must say that I never heard of that vessel until about half a year ago, and I believe it was patented then; whereas this fort has been patented three years. I cannot say how long that invention has been in operation; but I can say that mine has been patented for three years, while this has been patented for about six months. I only say this for your information. I was not aware that that invention had been brought forward. I do not wish to depreciate any person's plan; I wish that the best plans for the defence of the country may be employed. This

is the battery which I have invented; it has cost me time, trouble, and expense, and if never brought into practice, why there it is. I consider that it will carry the heaviest armour-plating, and be able to defy all modern artillery. Having no greater angle than 22½°, and the arms only about 19°, I believe, according to the general opinion and the practice of modern artillery, that these forts cannot well be penetrated, especially when they have a greater thickness of plating to protect them than ordinary ships: the great floating area of the vessel enables it to carry an immense weight of armour-plating and also of artillery. Remember also that all the guns are brought towards the centre of gravity, so that there is no tendency whatever to cause the vessel to pitch, but rather a tendency to give ballast to that vessel, and to make her more stable than she would be, provided she had no weight there at all. With reference to the rudder there might be, if it was necessary, a temporary rudder, if she was going any distance. But in an engagement, a rudder would be objectionable, or anything else that projected outside the vessel. That is the reason why this hydraulic power is made choice of, because it will do more in a vessel of that shape than it can possibly do in an ordinary vessel. In an ordinary vessel there are two nozzles or places which the water proceeds out of. In this, there are eight places, which can be conveniently worked by valves, so that you have this advantage, that if a vessel was coming direct towards you, and you did not wish to encounter her, you have nothing to do but to open two of the valves and move out of her way; you have the power of moving the vessel any way, or of turning it round upon its centre, or reversing the movement, just as you please, by opening the valves. I make these observations for the information of the meeting, for there are, no doubt, gentlemen present who know more about batteries than I do.

Mr. HYDE: May I be permitted to explain. I may say that ten years ago—

The CHAIRMAN: The question certainly is one that has no relation to priority or merit of invention whatever. The question that must occupy the attention of the meeting at this moment is the very remarkable lecture that we have heard on this subject of floating *versus* fixed forts. We are not at this moment discussing any particular form of fort, though I may say the meeting will be delighted to hear the opinions of any gentleman on the subject of the shape or the nature of any floating fort that he may wish to advocate before this meeting. But after all, our great purpose in meeting here to-night is, I think, to discuss with all the light that many people can possibly throw upon it, whether floating forts are essentially necessary for the defence of our coasts and harbours, whether they are preferable to the system of fixed forts, or whether they should be combined with fixed forts. In fact, our attention should be called to the discussion of that important question, how we shall fortify our roadsteads, whether by a combination of fixed and floating forts, or whether by floating forts alone, or whether, as subsidiary to that great argument, any kind of floating fort can be introduced to this meeting which will answer the purpose.

Mr. HYDE: I quite agree with your observations, Sir, but I beg to say that for very many years I have advocated the system of deflection for forts, whether on shore or at sea. We know that modern experiments have shown that no vertical structure that can be erected is able to withstand the direful effects of modern Artillery, and not being able to keep shot or shell out by vertical structure, it does appear extraordinary that a system of deflection has not been recognised in some form. This fort of Captain Moody's gives a remarkable example of the system of deflection. Artillerists say you cannot keep shot out of a vertical structure, and all the recent experiments at Shoeburyness have proved that assertion. If you cannot do that, the next best thing is to construct a fort or ship that will throw them off. Ten years ago the same idea occurred to me as a shipbuilder, and I ventured to submit to the Admiralty, models and designs to illustrate this particular question. I knew, then, that no vertical structure would ever be able to keep out the shot that would be used in the future; and anticipating that fact, I set to work to design a ship that should be able to withstand horizontal fire from any gun that might be made, assuming that deflection must be the process by which the shot or shell should be either thrown under the water, or over the ship. Hence, the lithograph which I have submitted to your notice. The lithograph is not ten years old, but the design is some twelve years old.

Mr. JAMES CHALMERS: I am glad to find that Mr. Mackie has rather over-estimated the effects of the railway accident which befell Captain Moody; and also that Captain Moody is so well able to defend his own system, and to give us further explanations respecting it. This is not my speciality, therefore I do not intend to go into the question of floating forts *versus* fortresses, further than one point on which I wish to throw out a remark, for the purpose of giving those concerned an opportunity of explaining a little further. That is, the question of sinkage—the possibility of this battery being sunk. Of course its value depends on its being able to maintain its position under all circumstances. I am not at all afraid of ships like the "Warrior" ever being employed successfully in sinking a battery like that. I think in such a case, the "Warrior" would pretty much resemble the cow that would come in contact with Stephenson's locomotive; it would not be good for the "Warrior." But there is a class of ships that suggests to us that something may come up very soon that would be very damaging and detrimental to a vessel like that. The class of ships I refer to is the "Monitor" class; the "Monitor" class of ships will prove very dangerous to all partially armoured ships. Now, wherever you have mosquitoes you have the mosquito hawk; wherever you are troubled with that pest the ant, you have the ant-eater; and whenever the "Monitors" become the pests of the ocean, you will have a class of ships built expressly for the destruction of "Monitors." They are very low in the water, and the ship to destroy them will be built high in the bow to run right over the "Monitors." The Great Western Railway of Canada had ferry boats made in order to cut their way through the ice. They had a sharp prow made first, and jammed that into the ice, and there it stuck. They then threw that aside, and built another boat with a broad projecting prow; with this, they got on the top of the ice, broke it, crushed it under, and threw it behind them. So a high-built spoon-bowed ship will run right over the "Monitor." I wish Mr. Mackie and Mr. Moody would give their attention to what would be the effect of such a vessel coming between the rays of this fort and running up upon her. That ship could also be built upon the same principle of deflection; and being built specially for running down, would require to carry no guns, no armament. Its mission would be to run up on, over, and crush down a battery of this description. These are suggestions which I throw out, not in any spirit of opposition, because I regard this as one of the most promising floating batteries that I have ever seen, but to give these gentlemen an opportunity of explaining a little further, if they choose, how that battery could be protected against being sunk in the manner I have suggested.

Mr. ZERAH COLBURN: I feel under some disadvantage in speaking on this paper at all, as I knew nothing of the proposition before I came into this room this evening. But with regard to the possibility of running down such a structure as this, I think every one here will be able to make a simple calculation for himself. I understood Mr. Mackie to say that the diameter of the floating battery is 180 feet.

Mr. MACKIE: 180 feet from ray to ray; 114 feet from curve to curve.

Mr. COLBURN: Well, supposing it to be circular, I have calculated that it would take a dead weight of 750 tons to put it down one foot in the water.

Mr. MACKIE: 55 tons brings it down one inch.

Mr. COLBURN: If it were circular it would require, I say, 750 tons of dead weight applied on the top of it to bring it down 1 foot; and of course to bring it down 6 feet, it would require 4,500 tons. A ship like the "Warrior," of 8,000 or 9,000 tons, could not in striking it, lift herself out of the water more than 2,000 or 3,000 tons. That would not put down a battery of that kind any very great depth. However, if the "Warrior" broke a hole through its outer section, so as to let the water in, of course it would go to the bottom. But I think the mere weight of a ship running on to it would not damage it. With regard to the remark of the gentleman about the ferry boat of the Great Western Company of Canada running on the top of the ice, it runs through the ice. I know the boat well.

Captain HAMILTON, late C. S. Navy: I merely wish to rise to bear out what Mr. Colburn has said about the difficulty of sinking this battery by a vessel running on the top of her. There was a remarkable action in Albemarle Sound, between a Confederate vessel called the "Albemarle," and four wooden gunboats. The "Albemarle" was iron-clad, and had a knuckle coming out underneath to increase

her flotation. The attempt was made to sink the "Albemarle" in the same way that it is proposed to sink that floating battery. The wooden boat got on the top of her in front, and remained there for 10 minutes; and while in that position, they continued the action and fired into each other. The wooden vessel slipped off, and the iron-clad got away, having had the muzzles knocked off two of her guns. Mr. Mackie will tell us where the water line is here.

Mr. MACKIE: As near as I can tell, the water line is there (pointing out the part).

Captain HAMILTON: In the Confederate vessels the knuckle is below the water line. That knuckle saved the "Tennessee" in the action at Mobile. The wooden vessels there were all provided previous to the attack, with an iron prow. Although some five or six of them in rapid succession rammed the "Tennessee" at full speed, after the action, on the report made by the Officer who surveyed the "Tennessee," there was not the slightest evidence whatever of any harm having been done by the ram. In the case of the "Merrimac" she had no knuckle; and if she had been rammed by the same vessel she would have been sunk in a very few minutes. So I think the knuckle in this floating battery will serve the same purpose as it did in the "Tennessee." It was but for the purpose of giving her the utmost flotation.

A MEMBER: Will Mr. Mackie tell us the height of the port-cills above the water?

Mr. MACKIE: I do not claim anything with regard to these port-cills. These were put in by the artist who made the design, and in their present state they are most objectionable. The plan that I advocate for any such vessel, or for any vessel at all, is that the port-holes shall be contracted as small as possible, be limited as nearly as may be, to the actual muzzle of the gun. There is no doubt that such a port-hole could be made for this vessel, allowing for a considerable range of vertical and horizontal training. I think a port-hole made as near the size of the muzzle of the gun as possible would be sufficient.

A MEMBER: I ask the question more in reference to the question that has been raised, as to a vessel like the "Monitor" getting astride one of the arms.

Mr. MACKIE: That is a question that I must leave till after the discussion, I simply answer the question.

Brigadier-General LEFROY, R.A.: There are two or three questions that suggest themselves to me as a landsman upon which I should like to make a few remarks. It is pre-eminently a nautical question whether such a vessel can be built at all, so as to be strongly framed together and capable of resisting ships running against her; whether she can be built for £84,000; whether she can resist a ram coming against her, of 8,000 tons, at the highest speed. All these are nautical questions that I do not propose to touch. To come back to some of the earlier observations of the lecturer with reference to the shore defences of the country, and to the necessity of supplementing them by floating defences. The lecturer appears to be under the impression that what he referred to as the modern system of fortification, is the system of fortification which is in existence at present. Just as in geology there is a pliocene and a pleistocene period, so in fortification there is a modern and a most modern system. There is not a work constructed in this country since 1860 which has the least resemblance to what is called the modern system of fortification. With regard to the Northern attack on the Confederate Forts, there is no question that the Northern attack predominated. The reason was, that the Confederate forts had very few guns of any size or power. It would be very different in our case. No shot would strike that would not make its mark and have some effect. Then, there are certain conditions to be fulfilled in any structure of the nature of a fort or battery, which has to be occupied for the purpose of defence. It must be habitable, for one thing. You may as well have a barrack composed of sentry boxes, as a battery composed of guns and embrasures. You want a great deal more than that; it has to be occupied by Officers, men, and stores; and under the patriarchial system of the British Government, by women and children. Then, there are certain conditions which are necessary to meet those requisites. I hardly see how they are to be met in this structure before us. It is true there is a considerable amount of space in those curves, but I do not see any provision for giving them light and ventilation. Then,

Mr. Mackie has spoken justly of the great advantage of contracting the aperture to very nearly the muzzle of the gun. But I think he has quite forgotten that the system answers very well in a turret where you lay your gun by rotating the turret. You cannot get any sight through an aperture of that description, where the body of the gun is very much larger than the opening, even if the turret in which it is mounted is itself movable. The contraction to an aperture of that extremely small size is contingent on your being able to lay the gun by extraneous sources, that is by rotating the whole turret. These are the observations which strike me at once. I quite agree with some of the previous speakers that such a structure as this, with six inches of iron on the lower slopes, and nine inches of iron on the upper slopes would be practically invulnerable. I do not think there is likely to be any gun that would breach it. Nor do I think it would be breached by vertical fire, certainly not by cast-iron shells, because they would be broken up by the impact. On the other hand, the opening in the centre is of considerable size; it appears to me to be 40 feet across. Now a circular opening of 40 feet is a very considerable opening, and vessels coming prepared to attack such a vessel would no doubt come prepared to take up the distance at which they knew the exact range of their mortars, and would, I think, before long, throw shells into that opening, and render it uninhabitable. I suppose that there is no one who will deny that there are situations, from the width of channel at different points on the coast to be guarded, where floating structures of some kind or other might be used. That question did not escape the attention of the Defence Committee in 1860. On the contrary they went into it, and considered both floating batteries and ships, properly speaking. Whether rightly or wrongly, they arrived at the conclusion that a ship which is habitable, ventilated on both sides, and capable of locomotion, and containing conditions for men and stores of every sort or kind, would be more suitable for any purpose of defence than a floating battery of any kind. Such was the conclusion then come to. I admit that no ship could have the stability of beam and bow which a structure of this kind would have. The radial form seems to me to be extremely well calculated to give stability, and stability is a matter of great importance. Therefore I am willing to concede that advantage. I think I know of situations in which, if such a thing existed, it might be very useful. But at present it appears before me as a ship with a broadside of three guns, costing £84,000, not habitable, or barely so, because we must remember that all structures that are meant for permanent purposes of defence, at all events for continual defence, can never be left unoccupied; they must in time of war or of alarm be continuously occupied in force. You cannot send the people off when you do not know when your enemy is going to attack you. It appears to me that this hardly meets those conditions, even if it should succeed in the opinion of naval architects in meeting the other conditions of such a structure.

Sir EDWARD BELCHER: The computation of Mr. Colburn is based on the immersion of a cylinder of a certain diameter, provided the weight be placed on the top of it. But if you take a wherry, and put your hand upon the side of the wherry, you can cant that wherry with one hand. Any vessel striking one side of that fort would cant it. I have seen that very model in the water, and tried it myself with the finger, and the slightest touch with your finger will depress it up to the guns. Consequently, I know what the effect of a ship of war running on to it would be; the weight of a ship of war would so cant it, that its guns would be perfectly useless; and they could not possibly fire. But putting that out of consideration, we know how far the vertical sides of a ship can be cut away to enable you to train a gun. But how much will you cut away of that inclined face to train a gun? If you placed your battery at the distance I am now, and anchored a turret ship slightly at one angle, so that both turrets could be brought to bear upon that ship, but two of your guns could possibly fire upon the turret ship, whilst four guns of the turret would look right down upon your deck. I consider the turret-ships we have now would destroy that thing inevitably in half an hour.

Mr. COLBURN: Although I was under the disadvantage of not knowing the dimensions of the floating battery when I came in, I know now from what I am told, that it is more like the island of Jersey than like a wherry.

Colonel JERVOIS, R.E., C.B.: There are one or two observations that I wish to make

to this meeting. I came in rather late, and I was not aware until Admiral Robinson said so, that this proposition for floating batteries was made *versus* forts. In my opinion there is no *versus* in the matter. I have always been an advocate for floating batteries. Ten years ago, I was instrumental in obtaining a Committee, for the purpose of considering the question of floating batteries; and in conjunction with Captain, now Admiral Cooper Key, and Colonel Wilmot, R.A., a proposition was then made as regards what we then considered the best kind of floating battery. The proposal was for a small vessel propelled by steam, with a fixed tower in the centre, guns within that tower, and the vessel to be movable from port to port. That was in the year 1858. It is strange how near that vessel approached to what we now call the "Monitor." No money was voted, however, for floating batteries; and the question slept until I think, about 1862, when the "Monitor" question was raised, after the battle between the "Merrimac" and the "Monitor." It will be in the recollection of those who have paid attention to the reports of the several committees and commissions that have discussed the subject, that floating batteries have always formed part of the proposals for the defence of our naval arsenals and harbours. It is, as I said before, not a question of ships *versus* forts, but of ships *and* forts. The question has also been gone into as to whether it was desirable to have stationary floating forts; and the result of a very close investigation of that matter, which time would not permit me to enter into now, was, that in no case was it desirable to have *stationary* floating forts; that if you have a floating fort, it is better at once to give it the power of motion, and somewhat rapid powers of motion; by so doing, you are able to concentrate a great number of vessels upon one point, and able to make use of them to a much greater extent than you could by having a kind of amphibious creature,—neither a fort nor a ship. There have been other propositions made, somewhat of the sort brought forward so ably this evening, one was by the late Mr. Herbert, of the Trinity Board. It was circular and domed, and pivoted in the centre at the centre of gravity, and it was to be anchored there. It was in certain respects different from the proposition which is now before us; but it was, nevertheless, as far as it went, an effective floating battery. My own opinion, whatever it may be worth as regards the subject of floating batteries, is, that the proper kind of floating battery is a "Monitor" vessel, with either one or two turrets, as the case may be; but that in addition to this, and probably to a greater extent than you would apply the "Monitors," you should have small vessels carrying one gun a piece. I saw in one of the scientific papers the other day the drawing of a vessel that appeared to me to answer that purpose admirably, a vessel called the "Staunch," designed by Mr. Rendel. That kind of vessel would only take ten or twelve men to work its gun. It costs only about £7,000. Supposing the battery brought forward this evening to cost £84,000, you would get twelve vessels of that kind for one of these. And those vessels could move about in shoal water, or in deep water. Supposing a hole was knocked in one of them, and supposing she went down, the men could get into a boat and row away; and you could get the vessel up again afterwards, if you liked. Her invulnerability is due to her small size. I would say that I desire to see floating batteries applied in conjunction with forts for the defence of our harbours; they are part of a system which has from the commencement been advocated.

Mr. WILLIAM SMITH: I think the design of Mr. Herbert was originally intended, if not exclusively, in the first instance, for floating buoys. It was circular in shape. Afterwards there was a proposition to fit it with guns, but I never heard that it was intended to move it from place to place, or that it was to have means of self-propulsion. I saw the first designs that were made, and those were deposited in the Admiralty. I believe the reference made by Mr. Moody this night to the design which was brought out by Mr. Hyde was made under a misapprehension. If I remember rightly, Mr. Hyde projected his plan some ten years ago. The vessel was not circular; it was not like this battery in any shape or way, but was really a steam vessel having a turtle back; that was the main feature of it. I think, although it is not usual to refer to any rival designs, and it is always well to avoid that certainly, that Mr. Moody has made some mistake in supposing this design of Mr. Hyde's has only been produced within the last six months; he has probably confused it with

something that no doubt is very vividly in his mind at the present moment. I had my attention called to-day, in expectation of hearing the paper of Mr. Mackie, to this specification of Mr. Moody's patent. I must say that I am very much surprised to hear Mr. Mackie describe a series of ingenious contrivances as embodied in the design of Mr. Moody which do not exist at all in the specification of Mr. Moody's patent. Of course a man can only be bound by that which he specifies, and all that has been ingeniously described by Mr. Mackie may have been or may not have been in the mind of Mr. Moody at the time he conceived this ship. It is little more than two ships of broad beam being placed across one another; but as to the idea of propelling the battery by hydraulic jets, I must say that I am rather surprised to hear Mr. Mackie say it is part of Mr. Moody's original design. I do not think it is material; it is very ingenious, but I think the ingenuity is more due to Mr. Mackie than to Mr. Moody, judging from the blue book which has been placed in my hand to-day. It is a very useful form of moored floating battery. I think Admiral Belcher is right in saying what he did as to the small amount of weight necessary to cause that vessel to cant and slide under the "Warrior," or any other vessel that may override her. I think it is quite a different case from a circular ship where there is a much more uniform and larger bearing. I think any vessel of the "Warrior" class running across one of those projections would certainly sink the ship. When that model was exhibited the other night at the Royal Society, where it was floating, you might have found that it was easily depressed by placing your finger on the end of that projection, so as to cause the battery to sink.

Mr. Zerah Colburn: I trust I may be allowed to make one other observation. I supposed the ship at first was a circular vessel, as I said, but with regard to tipping the ship over, of course the weight must either be applied directly on the top of it, or must be applied at one edge of it. We will draw a diameter across a circular ship, or take the longitudinal axis of a ship of any length whatever; to depress it on one side you have got to lift the same amount of weight out of the water on the other. It does not make any difference, you cannot upset it unless it has got a very low free board. Of course, if a vessel has only six inches or a foot, and you get it under water the water gets into it and it sinks, but not by running down. I think it ought to be said in justice to the late Mr. George Rennie, that he laid before the British Association in 1858 a plan for a floating battery. I do not know that it was identical with this, it was a circular floating battery. I cannot recollect whether he proposed to give it any means of propulsion, or whether he meant merely to moor it. It had angular sides and was heavily armoured. That was in 1858.

Sir E. Belcher: One fact is worth a thousand assertions, I have with a vessel of 340 tons so depressed a portion of a field of ice, seven feet in thickness, as to cause it to disappear under her bows.

Mr. Colburn: The ice was not of the same specific gravity as the ship you were sailing in, that is an important difference.

Admiral Halsted: I can venture to say that my friend, Mr. Herbert's proposal for a floating battery was from the first that it should have its own means of propulsion, not at any very great rate of speed, but so that it could be taken in or out of harbour, or from post to post. Its essential mode of action was a means of rotation.

Admiral Robert Gordon: I came here to-night without the slightest intention of taking any part in the discussion, hardly knowing, indeed, what the subject was, but some reference has been made to Mr. Herbert's principle of mooring, and to that only I wish to address myself. I may take upon myself to say that he *practically* knew very little about that. I can give Mr. Herbert the greatest credit for the ingenuity of the idea, of mooring from the centre of gravity. As far as small buoys were concerned, it answered perfectly, and the principle has been continued to the present time; but with large bodies it proved a total failure, they were perfectly unmanageable, and could not be retained in position with the strongest moorings, they broke adrift, they cost enormous expense, and were worse than useless. I do not wish to detract from the merits of a person now dead, but I happened to know from the commencement, something about these buoys; the principle was good, but on a large scale it failed entirely; it has therefore occurred to me, how could such a large body as that battery be moored?

Admiral HALSTED: I may say that I have taken as much interest in my late friend, Mr. Herbert's invention, as my friend here has. It was never tried but in two cases on the larger scale, and which failed under circumstances bearing no relation to the cause which has been suggested.

The CHAIRMAN: I think the time has arrived for the lecturer to answer the objections that have been made to his plan, and to combine in that answer any observations that may have occurred to him from the remarks that have been made by the various gentlemen who have taken part in the discussion.

Mr. MACKIE: It remains for me to say very little on the present occasion. I have to thank this audience for the courteous, able, and scientific manner in which they have discussed my paper. I would only say for myself that I simply placed it before them on account of the value that I thought attached to the stability of that fort. General Lefroy, I think, slightly misunderstood me, or rather perhaps I expressed myself somewhat too strongly with regard to limiting the port-holes to the exact size of the muzzles of the guns. What I meant to convey was, that I thought the object to be attained was to restrict the size of the port-holes to the narrowest possible limits. With regard to Admiral Belcher's view of running down this battery, I think I heard a remark from Mr. Colburn to the effect that this battery was more likely to run down the "Warrior" than the "Warrior" was to run down the battery. If he did not say so, I thought so myself. Mr. Colburn was perfectly correct that you cannot press one end down without lifting the other end out of the water. The flotation of one end is supported, but the weight to be lifted at the other end is a dead weight. I do not know what the weight is, but I know it must be considerable. I do not think with such a knuckle over as this battery has got, that any ordinary vessel could get on the top of it. This edge is well guarded, the armour plate is carried down underneath to the water line below it, therefore, I think, any ship, unless a very strong one, running upon this would certainly get some amount of injury. But I will go further than that, and I will suppose that Admiral Belcher has got his ship upon the top of one arm; I contend, then, that the form of that arm is such that it will draw out from under his ship. It is a curved wedge, and with the flotation of the water beneath, I maintain that this battery will pull herself out from underneath. With regard to Colonel Jervois's remarks upon fixed forts and fortifications, I purposely avoided any reference to the construction of forts; I am not very well aware of the discussion that has been going on on that subject. My object in bringing this matter before this audience is, that as a writer for a large and powerful journal, and associated with many gentlemen of ability who are capable of forming opinions, I desire sincerely to be informed upon certain points correctly and truthfully; beyond that, I have neither interest nor motive in bringing this subject before the meeting.

The CHAIRMAN: I think we are all extremely indebted to Mr. Mackie for the intelligent way in which he has brought this subject before us. In importance it is second to none. The defence of our shores and the defence of our arsenals is, no doubt, a subject which occupies everybody's mind with a very great degree of anxiety to combine those requisites for a proper defence. The general principles that Mr. Mackie started with at the commencement of his lecture must be admitted, I think, by everybody—the combination of floating defences with fixed defences on shore. I am afraid the discussion this night has not advanced much beyond the bare fact that I have stated; everybody wishes to see a combination of shore defences with floating defences, but, as is usual in all these matters, there is a great variety of opinion indeed as to how that combination shall be effected. Mr. Mackie has brought before us a very ingenious specimen of a floating defence, and I think the remarks that have been made upon it will probably enable himself and Captain Moody, perhaps, to modify or to improve this design, or set them thinking on some other design which shall be acceptable, and prove to be the best form of floating defence that can be used in combination with land defence. No doubt the attention of people cannot be too much called to these important subjects. Everybody here, I am sure, will agree in the vote of thanks that I propose to Mr. Mackie for the able lecture that he has given us.

Evening Meeting.

Monday, June 1st, 1868.

Admiral Sir Henry J. CODRINGTON, K.C.B., in the Chair.

NAMES of MEMBERS who joined the Institution between the 25th of May and 1st June, 1868.

ANNUAL.

Ward, Hon. W. J., Capt. R.N.
Playfair, W. M., Lieut. 107th Regt. 1*l.*

THE AMERICAN NAVY; ITS ORGANIZATION, SHIPS, ARMAMENT, AND RECENT EXPERIENCES.

By John Randolph Hamilton, Esq. (late C. S. Navy).

Mr. Chairman and Gentlemen,

At the request of your Council I have the honour to read you, this evening, a paper on the American Navy; its Organization, Ships, Armament, and Recent Experiences.

Although I do not assume in any way to be the representative of that Navy, I have, however, availed myself, in the preparation of this paper, of the recollections which remain of the fifteen years I passed in that service, and which have aided me, I trust, in avoiding a partial and prejudiced selection of the facts to be placed before you—facts derived for the most part from official reports published by the Navy Department at Washington, from such reports as I have been able to obtain from Confederate sources, and from private letters from, and notes of conversations with, competent and reliable authorities.

It is not my purpose to dwell on the earlier history of the United States' Navy, but after a few remarks upon its present organization, to pass to the consideration of those more recent experiences which will, I hope, enable you to form an opinion upon the merits and demerits of its ships and their armament.

Although the President of the United States is by law Commander-in-Chief of the Navy, the actual government of that department

is vested in the Secretary of the Navy, who is appointed by the President, with and by the consent of the Senate.

To aid the Secretary in the discharge of his duties he is assisted by the heads of the several Bureaux, which are appointed by him by selection from the different grades and corps of the service, respectively in relation to the duties to be performed. Hence the Chief Constructor of the Navy is the head of the Bureau of Construction, the Engineer-in-Chief that of Steam Engineering, and so on.

These several Bureaux form the Navy Department, and are most of them under the same roof with the Secretary of the Navy, who is the centre of information and authority, and who has, of course, a civil staff attached to his own office to assist him in the discharge of his immediate duties.

The authorized grades and corps of the Navy are not sufficiently different from those of your own Service, to render it important to enter into details of their organization.

Promotion is by seniority, and by selection for distinguished services during war.

There are on the active list of the line 592 officers of all grades from Admirals to Midshipmen inclusive.

No person can be appointed a Midshipman who has not graduated at the Naval Academy, to enter which he must be over 14 and under 18 years of age at the time of examination for admission, must be physically qualified to discharge the arduous duties of an Officer of the Navy, and must possess at least an elementary English education.

The course of instruction which reaches the higher branches of mathematics, astronomy, navigation, seamanship, gunnery, steam, naval architecture, and modern languages, extends over a period of four years, and the graduates pass to the active list in the order of their merit. There are at present on probation at Annapolis 344 Midshipmen-cadets, divided into four classes, and instructed, except in one or two departments, exclusively by officers of the line of the Navy, who are graduates of the Institution, and who are generally assigned by selection to this special duty for a term of three years. There are attached to the Academy two or more training ships, in which three of the classes cruize each summer to be instructed in practical seamanship, gunnery, and navigation.

Admiral Porter in his last report as Superintendent of the Academy, in speaking of the Department of Naval Architecture, says, "This will "finally come to be one of the most important studies at the Academy, "as well as the most attractive, and I hope the time is not distant when "the Navy will furnish its own constructors from Officers educated at "the Naval Academy."

So far it has fully answered the purposes for which it was created. From its organization in 1845, under Commander Buchanan, to the present time, with Admiral Porter as its Superintendent, it has enjoyed the confidence and support of the country and the gratitude of every man whose privilege it has been to participate in its advantages.

On March 4th, 1861, the Steam Navy of the United States consisted of the followihg vessels:—

No.	Rate.	Paddle or Screw.	Guns.
7	Frigates	Screw..	262
6	1st Class Sloops ..	„	109
8	2nd „ ..	„	41
5	3rd „ ..	„	28
4	1st „ ..	Paddle	46
4	2nd „ ..	„	8
34	wooden vessels of all classes and		494 guns.

At the commencement of the late American war, the problem which presented itself to the Government at Washington was, to blockade the seaports of the Confederate States, and to occupy them whenever their defences could be reduced; to gain control of the western rivers, and to cut the South in two from east to west.

To meet the Federal fleet the South was utterly unprepared. Of the means of creating even an efficient fleet of wooden vessels it was perfectly destitute, except in the trees standing in its forests, and the coal and iron which were hidden and undeveloped in its soil. There were no large ship-building yards, few factories of machinery, and but a limited amount of skilled labour. When I tell you that the bolts and fastenings of the armoured floating batteries built subsequently at Charleston were in part made of the lightning conductors taken from the ruined portions of that city, you will understand the extremities to which the Southern ship-builders were sometimes reduced.

In the summer and autumn of 1861 a fleet of partially armoured steamers had been built in the West, and early the next year opened up to the Federal transports the waters of the Tennessee and Cumberland rivers, covering the flanks of the advancing Federal Armies, and endangering the Confederate communications, and compelling the abandonment of Tennessee by the latter, and the loss of its supplies of food, iron, and coal.

Iron-clads.

The first naval operations of the war on the seaboard, were conducted in wooden vessels, but in August, 1861, Mr. Welles, the Secretary of the Navy, issued tenders for plans and estimates of armoured vessels, and in a few days afterwards a board of officers was convened to take into consideration the designs submitted to them. On the 16th of August they reported of Mr. Ericsson's model:—

"This plan of a floating battery is novel, but seems to be based upon "a plan which will render the battery shot and shell proof. We are "somewhat apprehensive that her properties at sea are not such as a "sea-going vessel should possess, but she may move from one place to "another on the coast in smooth water. We recommend that an "experiment be made with one battery of this description on the terms "proposed, with a guarantee, and forfeiture in any of the properties "and points of the vessel proposed. . . . . Price 275,000 "dollars (£55,000). Time 100 days."

It is so much the habit of the day for the outside world to find fault with and criticise the conclusions of professional committees, that I can refrain from asking you to bear in mind this report, and you will see the soundness of the opinions it expressed, were justified by subsequent events.

As completed, the following appear to be the leading dimensions of this floating battery, which was named the "Monitor:"—

Extreme length on deck over the armour	173 feet
Extreme beam on deck over the armour	44 feet
Depth	12 feet
Displacement	1,255 tons
Length of iron hull	127 feet
Width	36 feet 2 in.
Draught	10 feet
Projection of armour shelf forward	14 feet
Projection of armour shelf aft	32 feet
Thickness of side armour above water	5 inches
Thickness of side armour below water	4 to 3 inches
Thickness of backing	27 inches
Inside diameter of turret	20 feet
Height of turret	9 feet
Armour of turret in inch plates	8 inches

Armament two 11-inch 7½-ton Dahlgren guns.

The turret revolves upon a spindle, and not upon its base, as in Captain Coles's plan. The pilot-house was forward, and not on the top of the turret, as in the later monitors.

At the same time the Board advised the building of the "New Ironsides," a frigate of the following dimensions:—

Length	220 feet
Beam	60 feet
Depth	23 feet
Displacement	3,296 tons
Speed (estimated)	9½ knots
Armour	4½ inches
Horse-power, nominal	1,000

Armament—14 xi-inch Dahlgren's and two 150-pr. Parrot rifled guns.

The "New Ironsides" was built of wood and iron combined. She was a casemated vessel, with unarmoured extremities, and employed during most of the war in the operations against Charleston. It would seem, however, that the Navy Department at Washington, deemed the monitor system the best for the purposes of the war in which it was then engaged.

If we look at the "Monitors" employed in the war, as floating batteries, capable of making voyages along the coast, we shall be able to do far more justice to the excellence of the conception, than if we try to exaggerate them into ocean cruizers. Mr. Welles distinctly states

in his annual Report for 1864:—"Only two of the 'Monitor' class of "vessels, the 'Dictator' and the 'Puritan,' are proposed for sea "service. Their success, of which the builder and inventor is sanguine, is among the experiments that the period and the exigencies "of the country have imposed upon the department."

The conclusions to be deduced from the remarkable voyages of the "Miantonomoh" and "Monadnock," are not sufficient, I think, to promote even these two excellent monitors to the dignity of cruizing vessels; that is to say, vessels capable of keeping the ocean under all circumstances, in all latitudes, and in all weather, for six months.

Granting, however, that monitors of the "Miantonomoh" class are capable of carrying, under convoy, their 15-inch guns into any sea, and that they are an improvement on the earlier monitors, let us endeavour to ascertain from the experiences of actual war the value of the latter for the purposes of offence and defence.

The first action of the late American war between armoured vessels was that of the "Monitor" and the "Merrimack," in Hampton Roads, on the 9th March, 1862.

Action between "Monitor" and "Merrimack."

When the Federals abandoned Norfolk, in Virginia, during April, 1861, they partially destroyed the "Merrimack," a 42-gun frigate of 3,200 tons. The Confederate naval authorities, finding that she was uninjured from the water-line to the keel, decided to convert her into a casemated armoured floating battery, and to make her as strong as the limited means at their disposal permitted. The central part of the ship was covered with a roof of stout timber of oak and pine, 30 inches thick, and pitched at an angle of about 30°. The plating was 4 inches, in plates of 2 inches each. On the 8th of March she destroyed the "Cumberland" and "Congress," and on the 9th, fought the "Monitor" and "Minnesota" for four hours.

I do not find in the Federal despatches any details setting forth exactly the extent of the injury sustained by the "Monitor," but as it is stated she was ready for service the next morning, we may presume it was not serious. There is a letter from Chief Engineer Stimers to Mr. Ericsson, which is published by the Navy Department, and which throws a little light on the subject:—

"I consider," says Mr. Stimers, "that both ships were well fought, "we were struck twenty times, pilot-house twice, turret nine times, "side armour eight times, deck three times. The only vulnerable part "was the pilot-house, one of your great logs, 9 by 12 inches, is broken "in two. The shot struck just outside of where the Captain had his "eye, and it has disabled him, destroying his left eye, and temporarily "blinding the other. The turret is a splendid structure. . . . . "You are correct in your estimate of the effect of shot upon the men "on the inside of the turret when it was struck near them. Three "were knocked down, of whom I was one; two had to be carried "below, but I was not disabled at all, and the others recovered before "the battle was over."

I am glad to have it in my power to give you authentic information as to the condition of the "Merrimack," after her two days' fighting. Admiral Buchanan, who commanded her in the first day's encounter with the wooden fleet, was so severely wounded on that occasion, as to be compelled to turn over the command of the ship to his executive Officer, Captain Catesby Jones, and who commanded her in the action with the "Monitor."

When your Council did me the honour to ask me to prepare them this paper, I wrote to Captain Jones for information on the subject of the performance and condition of the "Merrimack," during and after her actions in Hampton Roads, and he wrote to me, to this effect, in October last:—

"The 'Merrimack's' efficiency and strength were very much ex-
"aggerated, by both the South and the North; she was one of our
"weakest iron-clads. In the 'Atlanta' the roof extended beyond the
"side some feet, forming a knuckle, which added very much to the
"strength and efficiency of the vessel. The 'Tennessee,' also, had
"this knuckle, and it enabled her to stand, without injury, being run
"into repeatedly by heavy vessels in the Mobile fight. Now, the
"'Merrimack' had no knuckle. The roof commenced at the side, it
"did not project at all beyond. The screw was exposed; in fact, it
"had no protection whatever, any small tug could have disabled us.
"The prow was of cast-iron, and not properly secured to the stem,
"consequently, we saw no more of it after running into the 'Cum-
"berland,' and when we ran into the 'Monitor,' struck her with the
"broad jagged wooden stem. A good prow might have done mischief,
"although the speed on striking was not great.

"Our battery consisted of four single-banded rifled guns, two
"8-inch, and two 6·4-inch, and six 9-inch Dahlgren smooth-bores.
"*We had no solid shot on board, except a few 9-inch of reduced diameter,*
"*to be used as hot shot,* consequently were unprepared to fight an iron-
"clad, although we did fight the 'Monitor,' until she ran into shoal
"water, where we could not follow. See the Federal Report of Cap-
"tain Van-Brunt, who commanded the 'Minnesota.'

"My opinion was asked before Commodore Tatnall's Court of In-
"quiry, as to the relative strength of the two vessels, and I replied,
"that the 'Monitor' ought to have sunk the 'Merrimack' in fifteen
"minutes. I really thought she might have done it in five. Her pro-
"jectiles of 11-*inch* broke our armour, and caused the wood backing to
"bulge in-board, *but none of the projectiles went through.* Our great
"draught of water, 22 feet, interfered very much with our movements,
"and ultimately caused her destruction. We got aground once during
"the fight with the 'Monitor,' in spite of all of our care, and could
"only pass the bar once in 24 hours, or we would not have gone up
"when we did.

"When we came out of the action, a portion of the roof was only
"awash. We had but one inch of iron below the roof—a single shot
"there would have sunk us."

The passage which corroborates Captain Jones's statement as to the "Monitor" retiring first from the action, will be found in an extremely

well-written despatch, addressed to the Secretary of the Navy at Washington, by Captain Van Brunt, and dated on board of his ship, the "Minnesota," the day after the action.

The "Monitor" you will remember was lost south of Cape Hatteras in the following December, and with her perished four officers, and twelve of her crew. The rest on board were saved by the quarter-boats of the "Rhode Island," the steamer that was towing her towards Charleston. Of the cause of this disaster to the "Monitor," her Commander says in his official Report:—

"I am firmly of the opinion that the 'Monitor' must have sprung "a leak somewhere in the forward part, where the hull joins on to the "armour, and that it was caused by the heavy shocks received, as "she came down upon the sea."

However unfit this little vessel was to face the wintry weather of the North Atlantic, yet she rendered valuable services to the Federal cause, and by her presence at Hampton Roads, retained the control of the waters of that bay, which was at one time apparently lost to the Federals, and indirectly caused the destruction of the "Merrimack," when Norfolk was evacuated by the Confederates, because her great draught prevented her being carried into James River. To have lightened her up sufficiently to pass the bars of the river, would have exposed the unarmoured portions of the hull below the usual load line, and have given the "Monitor" and her wooden consorts the opportunity for which they had so patiently awaited, either to capture or sink her.

Monitors of the Passaic Class.

The Government at Washington, and the Congress of the United States, greatly elated at the performances of the "Monitor," immediately after her action with the "Merrimack," ordered the construction of nine other vessels on the same system, but somewhat larger, and of what is known as the "Passaic" class.

Leading Dimensions of Monitors of the Passaic Class.

Length on deck	200 feet
Width on deck	45 feet
Depth on deck	12 feet
Length of hull proper	159 feet
Width of hull proper	37 feet 8 inches
Overhang of armour shelf forward	16 feet
Overhang of armour shelf aft	25 feet
Tonnage	844 feet
Draught of water	10 feet
Thickness of side armour in inch plates ..	5 inches
Thickness of side backing	39 inches
Thickness of deck plates	1 inch
Thickness of turret in inch plates	11 inches
Inside diameter of turret	20 feet
Height	9 feet

Armament, two 15-inch 20-ton smooth bores, or one 15-inch, and one 11-inch, smooth-bores, or one 15-inch, smooth-bore, and one 150-pr. Parrot rifled gun.

New Orleans.

Pending the construction of these vessels, which were intended primarily for operations against Charleston, and after its reduction, that of Savannah and Mobile, Admiral Farragut made his passage of the New Orleans forts, with his wooden fleet, and destroyed the Confederate flotilla that opposed his progress up the river to the city (Plate xii, fig. 3).

These forts which stand on the banks of the Mississippi, diagonally opposite each other, and about a mile and a quarter apart, are casemated brick structures built before the war, and deemed by the United States' Engineers an ample defence for the City of New Orleans, and the entrance of the Mississippi River. In this belief, the good people of New Orleans, and the Confederate General commanding the department seemed also to have indulged, until the genius of Admiral Porter, giving direction to the dash of Admiral Farragut, disturbed the dream of security, when it was too late to ward off the fatal blow, which gave the Confederacy its first mortal wound.

Federal Fleet.

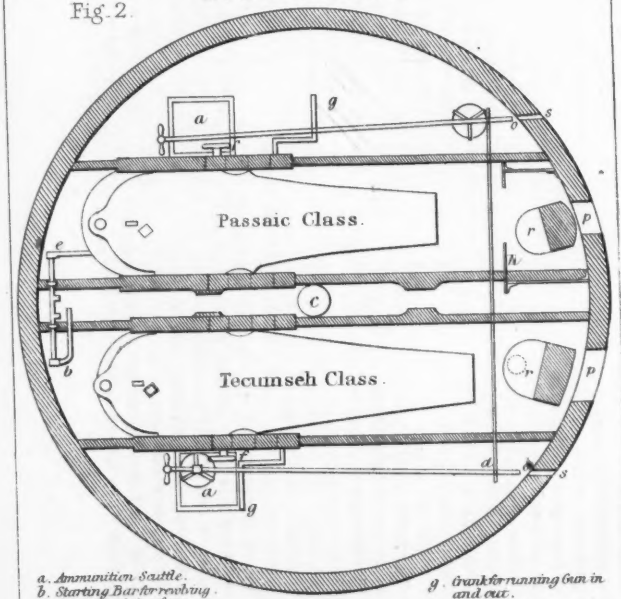
Admiral Farragut's fleet consisted of about thirty steamers, the "Hartford" with a battery of heavy 9-inch guns, being the flag-ship. There was a flotilla of nineteen mortar-vessels, each carrying a 13-inch mortar, under the immediate command of Admiral Porter, to whom was due the conception of reducing the forts by a bombardment from heavy mortars, and when the offensive powers of the fortifications were greatly weakened, to cut the communication with New Orleans, by forcing the passage at night with the steamers, under the cover of a heavy fire from the mortar-flotilla, and its supporting gun-boats. This was accomplished after six days' bombardment, on the first of which 1,400 shells were thrown, from distances of from 2,850 to 3,680 yards. The mortar vessels were hidden from the forts by the forests on the river banks.

Admiral Porter in a paper on Coast Defences, which has been published by the United States' Navy Department, refers to this bombardment, and its effect in facilitating the passage of the vessels under Admiral Farragut:—

"I recommended," says he, "in the early part of the Rebellion an "attack on the forts at the entrance of New Orleans, Forts Jackson "and St. Philip. I consulted with General Barnard, who furnished me "with correct maps and plans, and agreed with me in opinion that the "forts could be taken by ships and bomb-vessels. All the guns of "these forts that were of any use were *en barbette*. The few that were "casemated, were nearly level with the water, the fort having settled. "The history of that event is well known. The mortar-vessels had "disabled Fort Jackson, so that no ships were struck on that side, "and the men from the exposed guns of Fort St. Philip were driven

MONITOR TURRET.

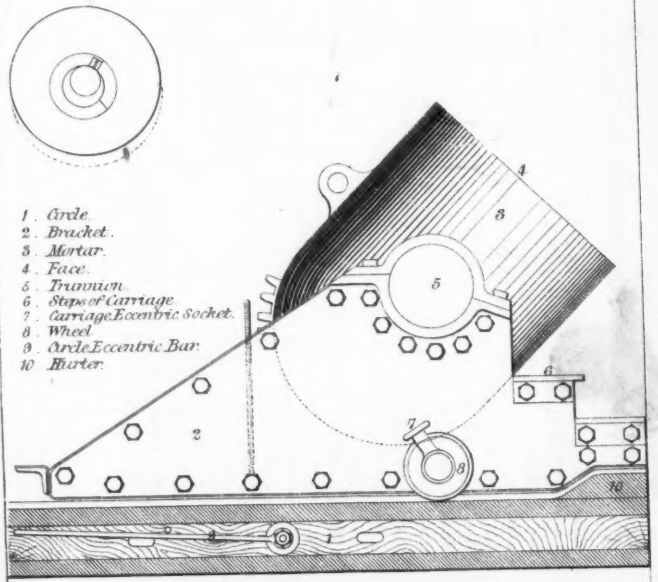
Fig. 2.



a. Ammunition Saddle.
b. Starting Bar for revolving Turret & training Gun.
c. Shaft on which Turret revolves.
d. Travelling Bar on which moves the shell whip.
e. Position of Engineer to revolve Turret & train Gun.
f. Compressor Wheel.
g. Crank for running Gun in and out.
h. Smoke Box.
o. Officer at sight hole
p. Port hole. r Port stopper
s. Sight hole.

MORTAR.

Fig. 1.



1. Circle.
2. Bracket.
3. Mortar.
4. Face.
5. Trunnion.
6. Steps of Carriage.
7. Carriage Eccentric Socket.
8. Wheel.
9. Circle Eccentric Bar.
10. Hurter.

J. Jobbins.

"to shelter after a few broadsides from the vessels as they passed. "The best resistance opposed by the enemy was from some rams "and gunboats, but they were soon demolished, and the ships "passed up . . . . . Here were two forts mounting near 100 "guns, that were passed by a squadron of wooden ships with shell "guns, when the enemy had strong currents on their side, and bad "shoals to interfere with the progress of our vessels. It was perhaps "one of the most difficult positions for ships at night amid smoke, "flames, and rams, and in my opinion, settled the problem about "steamships passing forts when there was plenty of water. In this "instance only a fleet of well-constructed monitors or powerful rams "could have stopped the advance of our fleet."

Every effort had been made to get ready to participate in the defence of New Orleans, a powerful armoured-floating battery the "Louisiana." The Federals through their spies were well informed of the actual condition of this vessel, and her consort the "Mississippi," and consequently urged forward the preparations for the attack, which took place before the "Louisiana's" machinery was completed, and before "the Mississippi" had received her plating. Both vessels were set on fire to prevent their falling into the hands of an enemy, that either of them could have destroyed a few weeks later.

Naval Mortars.

The diagrams Nos. 1 and 2 (see Plate xi, fig. 1) show the method of mounting mortars on board mortar-vessels in the American Navy.

The carriage and slide are of wrought-iron, the latter secured to the circle or turn-table (1). The carriage is mounted upon excentric wheels (8), which are thrown in or out of gear by placing the levers in the excentric sockets (7). Before firing, the wheels are put out of gear, and the carriage rests upon the slide upon which it recoils; when the piece is to be run into battery after loading, the wheels are thrown in gear, by again placing the levers in the excentric sockets, and heaving upon them. By an arrangement of the excentric axle, the wheels remain in gear when the levers are withdrawn, and placed in the holes in the rims of the wheels, and by heaving forward, the mortar is run out. The turn-table is also mounted on excentric wheels, which must be thrown in gear, and kept so by pinning down the circle excentric-levers, while the piece is being trained. The piece shown in the diagrams is a sea-coast, 13-inch mortar, weighing 8 tons.

Working of Monitor Guns.

Before passing to the consideration of the operations against Charleston by the iron-clads under Admirals Dupont and Dahlgren, I will, in as few words as possible, explain the manner of working the guns and turrets as shown in diagram No. 3 (Fig. 2).

The rammer and sponge are in sections, which are screwed together as the sponge and the rammer are passed down the bore, and are unscrewed as they are withdrawn. This is a consequence of the limited

space for loading in the turret. The powder is received through the ammunition scuttle, *a*, as is also the shell or shot, which is whipped up to the travelling bar, *d*, on which the shell whip moves, and which bar is brought over so as to permit the projectile being placed in the muzzle when it is rammed home with the rammer in sections, as already described. To run out the gun, the compressor, *f*, is eased, the truck-crank, *g*, is manned, and as the muzzle approaches the port-stopper, *r*, the port is opened. The gun being out, the compressor is hove taut, first by hand, and then by the ratchet levers. To train, the officer at the sight holes, *s*, orders right or left, as the muzzle is to go, and the Engineer at the starting-bar, *b*, revolves the turret, the Officer gives the order to fire, and the Captain of the gun pulls the lanyard. The port tackle is let go, and the port stopper closes the port. The Engineer revolves the turret so as to point the gun abeam, which gets the scuttles clear for passing ammunition.

The crew of a 15-inch gun consists ordinarily of 14 men, but the gun may be worked with 8. Some officers prefer the smaller number as being equally efficient, and giving more room in the turret. The allowance of projectiles is limited to about 150 rounds per gun. All 15-inch shell are fitted with three fuze holes, to take 3½, 5, and 7 second fuzes; when the range is shorter than the range of shortest fuze, all are uncapped, otherwise the fuze suited to the distance is uncapped.

Charleston.

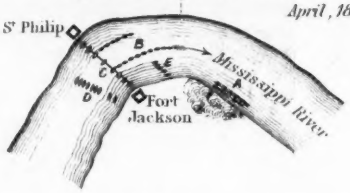
Diagram (Plate xii, fig. 1) shows the position of the attacking fleet of Federal iron-clads on the 7th or 8th April, 1863, and the defences of the harbour of Charleston and adjacent islands, marked with red flags. The coloured circles are for 500, 1,000, 2,000, and 3,000 yards. There were two lines of obstructions. The outer one, between Fort Sumter and Sullivan's Island, was made in lengths of strong rope netting suspended from hempen hawsers, and was buoyed with casks, the hawsers being anchored at the extremity of each section, and the netting weighted at the bottom very much like a seine. The inner obstructions (Fig. 2) were composed of a double row of timber pilings, which were covered by the guns of the batteries in rear of the obstructions. If there were any torpedoes in position they were not brought into play; or they failed from their early and imperfect construction to assist in the defence.

The Government at Washington greatly over-rated the endurance and offensive powers of the iron-clad fleet, consisting of the "New Ironsides," seven monitors, and the "Keokuk," and with which Admiral Dupont moved up from the anchorage inside the bar on the afternoon of the 7th of April, 1863, with the intention of taking up a position off the N.W. face of Fort Sumter, and reducing that fortification in a few hours.

The order for the attack appears to have emanated from the Navy Department on the 6th of January, for on that day Mr. Gideon Welles writes to Admiral Dupont, "that several additional iron-clads had been "ordered, and are now on the way to join your command to enable you

Fig. 3.

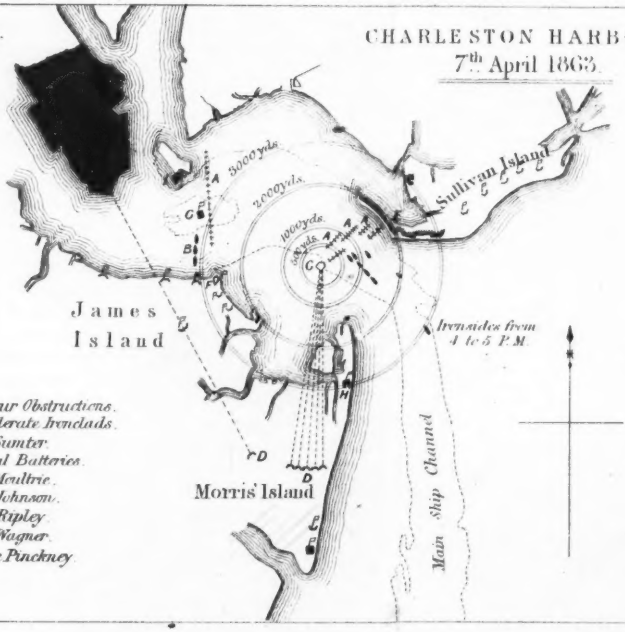
PASSAGE OF THE NEW ORLEANS FORTS
BY THE FEDERAL FLEET.
April, 1862.



A. Admiral Porters Mortar Flotilla, B. Admiral Farraguts Fleet.
C. Obstructions, Hulks anchored up stream and chained together but broken through by Federal Gunboats & Floods in the River.
D. Confederate Gunboats, E. Gunboats of Mortar Flotilla.

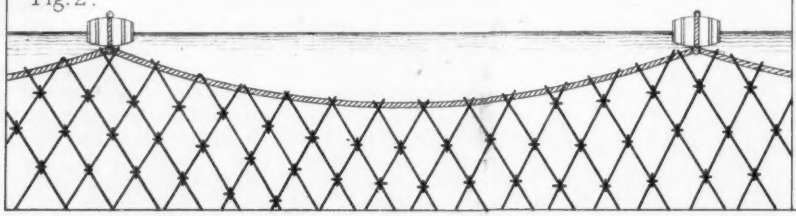
Fig. 1.

CHARLESTON HARBOUR
7th April 1863.



A. Harbour Obstructions.
B. Confederate Ironclads.
C. Fort Sumter.
D. Federal Batteries.
E. Fort Moultrie.
F. Fort Johnson.
G. Fort Ripley.
H. Fort Wagner.
I. Castle Pinckney.

Fig. 2.



Fig

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Fig 5

A 150 P
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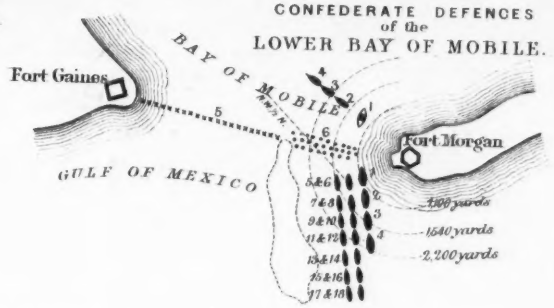
Fig. 4.

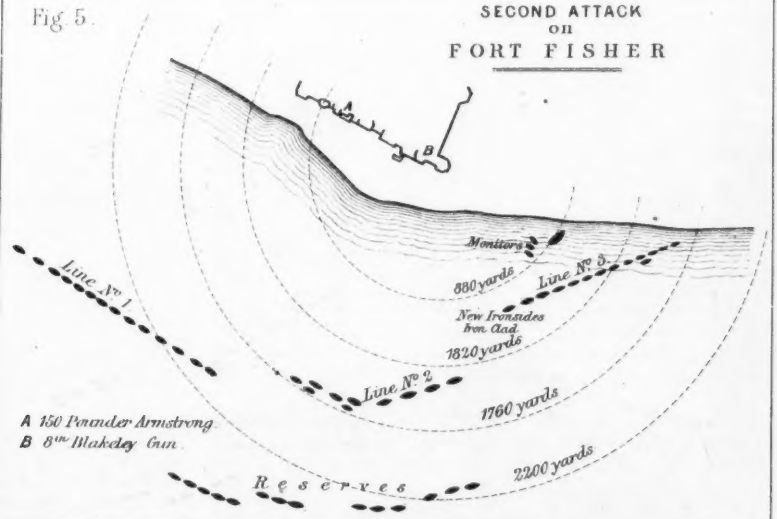


FEDERAL		
1	Monitor	Tecumseh.
2	"	Manhattan.
3	"	Winnebago.
4	"	Chickasaw.
5	Steamer	Octarara.
6	"	Brooklyn.
7	"	Metacanet.
8	Flagship	Hartford.
9	Steamer	Port Royal.
10	"	Richmond.
11	"	Seminole.
12	"	Lackawana.
13	"	Kennebec.
14	"	Monongahela.
15	"	Itasca.
16	"	Ossipe.
17	"	Galena.
18	"	Oneida.

Plan of
FEDERAL ATTACK
of 5th Augt & following days.

CONFEDERATE		
1	Ram	Tennessee.
2	Gunboat	Gaines.
3	"	Morgan.
4	"	Selma.
5	Piles.	
6	Torpedoes.	

Fig. 5.



J. Jobbins.

"to enter the harbour of Charleston, and demand the surrender of all "its defences, or suffer the consequences of a refusal."

In his detailed report of the action, dated the 15th of April, and which will be found in the Secretary of the Navy's report for 1863, Admiral Dupont says:—

"No ship had been exposed over forty minutes, and yet in that brief "period, as the Department will perceive by the detailed reports of the "Commanding Officers, five of the iron-clads were wholly or partially "disabled, disabled too (as the obstructions could not be passed), in "that which was most essential to our success—I mean in their arma-"ment or power of inflicting injury by their guns. . . . . "I was convinced that persistence in the attack would only result in "the loss of the greater portion of the iron-clad fleet, and in leaving "many of them inside of the harbour to fall into the hands of the "enemy."

There were mounted on the Federal iron-clads that participated in this action, and which, except the "Ironsides," were presumed improvements upon the original "Monitors," the following guns:—

Smooth-bore.				Rifled.		Total Guns.	Number of Fires.
15-inch.		11-inch.		150-pr. Parrot.			
No.	Charge.	No.	Charge.	No.	Charge.		
	lbs.		lbs.		lbs.		
7	35	20	15 & 20	3	16	30	139

Of the total number of shot fired, the "New Ironsides" delivered eight. In the smoke and tideway of the Channel, she seems to have become on this occasion utterly unmanageable, and had to anchor twice to save herself from going ashore, never having been able to bring her guns to bear on Fort Sumter, but directing them on Fort Moultrie and Battery Wagner. The Officers of the Monitors experienced great difficulty in managing their vessels, and keeping them clear of each other and the bottom, with the limited field of vision, the look-out holes in the pilot-house, afforded.

The guns and charges employed by the Confederates were as follows, and you may rely upon the authenticity of the statement, as I have taken it from General Ripley's official report, under whose command were the immediate defences of Charleston harbour, who perfected or designed the best of the earthworks, and under whose anxious supervision the troops were organized and prepared for battle.

RETURN OF GUNS AND MORTARS AT FORTS AND BATTERIES IN CHARLESTON HARBOUR, APRIL 7TH, 1863.

Calibre.	Smooth-bores.				Rifled Guns.			Mortars.
	ins. 10	ins. 9	ins. 8	prs. 32	ins. 7	ins. 7 light	ins. 6·4	ins. 10
No. of guns ..	10	3	19	18	2	7	8	9
Charges ..	15 lbs.	10 lbs.	10 lbs.	8 lbs.	15 lbs.	8 lbs.	6 lbs.	5 to 10 lbs.
Weight of shot.	128 „	90 „	65 „	32 „	120 „	70 „	64 „	90 „
Number of fires	385	80	736	343	86	140	366	93

Total number of guns of all calibres	76
Do. „ fires „	2,229
Do. „ pounds of powder used	21,093
Greatest charge of powder	16
Do. weight of shot	130
Average charge of powder	10

We will now refer again to the Federal official reports, to learn the amount of damage done to their iron-clads by the fire from the Confederate batteries; and that you may justly estimate the effect of that fire, I must ask you not only to bear in mind the comparatively light charges and projectiles employed, but to remember that none of the latter were either chilled or of steel.

I read from a report drawn up by six of the Commanding Officers of the Monitors, and which is published with the Secretary of the Navy's report for 1863.

"1st. 'Passaic.' A large piece of brassing under turret broken off, "owing to which, and its being forced over, the turret could not be "moved for some time, and has not worked well since. The gun-"carriage of the 11-inch gun disabled until the next afternoon, and "the top of the pilot-house forced up, so as to expose the inside to "shot, and not got in place until late the next day.

"2nd. 'Weehawken.' Side armour broken through, exposing wood. "The flange supporting gun-platform broken, smoke-stack very much "injured, and both this and the turret greatly weakened from loss of "bolts, the latter for a time stopped.

"3rd. 'Patapsco.' Rifled gun disabled at fifth fire, smoke stack "penetrated in several places through upper part of armour, out of "which were forced forty bolts, rendering the whole structure very "insecure until strengthened again, besides this the turret had been "stopped for a time.

"4th. 'Nantucket.' 15-inch gun lost at third fire, owing to a blow "on turret jamming the port stopper, which could not be moved after-"wards. The turret stopped several times, besides severe injury to

"smoke-stack and deck. The concussion box in this short time lost "eight bolts, and the turret was made to move with great difficulty.

"5th. 'Nahaut.' Lost seventy-six bolts from the turret and pilot-"house, the latter very much injured. The steering gear deranged, "and the plates started. The braces that hold down the inner gun "tracks, and brace of turret knocked off, and turret rendered im-"movable, and not cleared until 5 o'clock the following afternoon. Even "at present, after long repairs, it can only be made to revolve very "slowly, with thirty pounds of steam."

Speaking of the Monitors generally, these Officers say:—

"The liability of the guns to become disabled on occasions which "require steady use, has been shown, as well as that the turret almost "invariably refuses to work after receiving heavy blows from shot, "not only because the consequent bulging-in injures the machinery, "but from its being pushed from the perpendicular."

The "Montauk" was hit fourteen times, but received no material damage; she was commanded by Captain Worden, who says:—

"Had the attack been continued it could not have failed to result in "disaster."

The "Catskill" was struck "some twenty times, but without any serious injury. The 'Keokuk' was struck 90 times, and completely riddled, and sunk after the action, her guns falling into the hands of the Confederates. She differed from the Monitors in many essential points."

These were the experiences obtained by the Monitors after an action, which lasted so short a time, that the Confederates considered it simply a preliminary attack. Yet, although they revealed defects in the details of their construction, particularly, I think, in their laminated turrets, and armour, and in the central spindle system of revolving the former, still we must remember, that although these seven vessels were hit 256 times, the least number received by any one being 14, and the greatest 53 times, the list of casualties was insignificant.

Opposed to ordnance considered powerful against unarmoured vessels, there is no evidence to show that either the hulls or the turrets of any of the vessels, except the "Keokuk," were penetrated by shot. Yet wooden vessels, placed in a similar position, would have come to inevitable grief. Nevertheless, had the Confederate fortification been armed with either steel, or steel and wrought-iron guns of no higher calibres than 8 and 9 inches, firing Major Palliser's lancet-headed chilled projectiles, with charges of 30 and 43 lbs. of powder, it is my conviction,—if I may be permitted to have one,—that the whole Monitor fleet would have shared the fate of the "Keokuk."

Fort Sumter, you are no doubt aware, is a brick structure, with two tiers of casemates, and a battery *en barbette*. The walls were 5 feet thick on the faces of the arches, and 12 feet between the arches. The effect, according to General Ripley, of the 15-inch shot, at distances of from 1,200 to 1,500 yards, was a greatest penetration of 30 inches—twice its diameter, and a mean penetration of 15 or 18 inches. Where two shot struck the face of one casemate, a crack extended through, and, if struck once or twice more, in the same place, would have breached

the casemate. Fire of the iron-clads very slow and fairly accurate. Estimated distance 900 to 1,900 yards. The Federals estimated the range at which the action was fought, at from 550 to 2,100 yards. The position of the fleet on the chart is a compromise between the two estimates. After the repulse of the fleet, no further attempt was made to pass the fortification, and take the city by a naval force; not even when General Gillmore had got complete possession of Morris Island, and reduced Fort Sumter to a shapeless ruin—a ruin which I am sure you will pardon me for reminding you, a gallant garrison held until Charleston was evacuated in the winter of 1865. Admiral Dahlgren, who relieved Admiral Dupont, in command of the fleet off Charleston, expresses himself generally satisfied with the endurance and efficiency of the Monitors, which were under his command for a period extending over nearly two years. In a written opinion of their performances, he says:—

"The force of a 10-*inch* shot (spherical) must be experienced to be "appreciated. Any one in contact with the part of the turret struck "falls senseless, and I have been nearly shaken off my feet in the "pilot-house when engaging Moultrie.

"All the little defects of details were marked by such a searching "process. Decks cut through; cannon worn out; side armour shaken; "tops of pilot-houses crushed, &c. But all these were repairable, and "no vital principle was touched."

The services of the Monitors after their repulse by Fort Sumter, were confined to assisting General Gillmore in his siege operations against Fort Wagner, an earthwork mounting seven guns on its sea-faces, and which the Monitors and the "Ironsides," although frequently attacking, were unable to reduce, so that it could be assaulted successfully. I take it, that the experiences at Charleston go to show that the turrets of the Monitors of the "Passaic" class, which are 11 inches thick, in 1-inch plates, can be disabled, but not penetrated, when struck fairly by a 10-*inch* spherical, or 7-*inch* rifled shot of cast-iron, with charges of 16 lbs. of powder, at distances not exceeding 1,000 yards.

"The heavy shot fired," says Admiral Dahlgren, "which have "struck, have generally been 10-inch, and are well borne at 1,200 yards, "but when the distance is less than 1,000 yards, there is a marked "difference."

In the operations against Charleston, it must be borne in mind, that the Monitors had a harbour of refuge at Port Royal, sixty miles off, whither they could go to be repaired, and where one or more of them were always in the hands of the engineers detailed to look after them. Without Port Royal, they could not have continued their operations against Charleston for three months.

Capture of the "Atlanta."

Not long after the attack on Sumter, the Monitors, "Weehawken" and "Nahaut," captured the Confederate iron-clad "Atlanta." This vessel was originally a Clyde-built screw-steamer, which was diverted

from her peaceful pursuit as a trader on the west coast, and put to running the blockade. Arrived at Savannah, she was converted into an iron-clad, somewhat after the manner of the "Merrimack." In endeavouring to go from Savannah to Charleston, she got aground in one of the sounds on the coast of Georgia, and in that predicament was attacked by the two Monitors. The "Weehawken" appears to have done most of the work. She fired five shots at distances of 300 yards, four of which hit, two being 15-inch, and two 11-inch.

One 15-inch cored shot struck the side of the casemate on a line with the port-holes. It broke the armour completely through, although its course was somewhat oblique. The wooden backing was much splintered, and several bolts were withdrawn from their places. It left a large hole entirely through the plating and backing, *although the shot itself did not go through.* Forty men were knocked down by the splinters and concussion of this shot, and more or less injured. Sixteen were found to be seriously wounded, of whom two or three died.

The armour of the "Atlanta" was four inches thick, in two plates of two inches each, bolted to an oak and pine roof pitched at an angle of 29°, and which was 18 inches thick. Her armament was two 7-inch and two 6·4-inch cast-iron rifled guns.

Of the Monitors employed during the war at Charleston, the "Weehawken" went down at her anchors inside of Charleston Bar. The mischief in this case seems to have been done by the entrance of water at the base of the turret, and through the hatches, hause-pipes, &c. At the time the wind was fresh from the N.E., but there was not much sea on.

The "Patapsco" was destroyed by running on a stationary torpedo, which sunk her in less than thirty seconds. Sixty-two of her officers and men went down with her.

The speed of the Monitors of the "Passaic" class, with clean bottoms and smooth water, is about 7 knots; but when the bottom becomes foul it falls to 3 and 4 knots. They turn quickly and in less space than most vessels.

Mobile.

At Mobile you will see, by referring to the chart (Plate xii, fig. 4), that Admiral Farragut's fleet consisted of fourteen wooden vessels and four Monitors, carrying 125 guns. In the first order of sailing, the wooden vessels were lashed in couples, the heaviest vessels being nearest Fort Morgan, and covering the four leading pairs of vessels, were the four Monitors. The Admiral did not consider it necessary on this occasion to inflict upon the fort a preliminary bombardment, his object being simply to effect the passage of its guns, to cut off communication with the town of Mobile, and to leave the reduction of the fort to the Army with siege guns, assisted by shelling from the fleet when in possession of the bay. The passage was made by all the fleet in 45 minutes from the time of weighing anchor, and with the loss of but one vessel, the Monitor "Tecumseh," destroyed by a torpedo. Fort Morgan mounted 136 guns, the heaviest being 10-inch columbiads.

After passing the fort, the Admiral was about to anchor his fleet, when he discovered the "Tennessee," commanded by Admiral Buchanan, bearing down upon him. He immediately made signal to such vessels as he thought suitable to engage her. The "Monongahela," a wooden 7-gun screw steamer, was the first to strike her, and in doing so, carried away her iron prow, together with her cut-water. The "Lackawanna," 7 guns, struck her next, at full speed, but though her stem was cut and crushed to the plank ends above and below the water line, the only perceptible effect on the ram was to give her a heavy list.

The "Hartford," flag-ship, wooden, 21 guns, was the third to strike the "Tennessée," the blow was a glancing one, but as she rasped along the iron-clad's sides, she poured her whole broadside of 9-inch solid shot into her, within ten feet of her casemates.

"The Monitors," says Admiral Farragut, "worked slowly, but de-
"livered their fire as opportunity offered. The 'Chickasaw' succeeded
"in getting under the 'Tennessee's' stern, and a 15-inch shot from the
"'Manhattan' broke through her iron plating and heavy wooden
"backing, *though the missile itself did not enter the vessel.*"

The Admiral says, "that when the 'Tennessee' surrendered she was
"sore beset. The 'Chickasaw' was pounding away at her stern, the
"'Ossipie' was approaching her at full speed, and the 'Monongahela'
"and 'Lackawana,' and this ship (the 'Hartford') were bearing down
"on her, determined on her destruction. Her smoke-stack had been
"shot away, her stearing gear was gone, and several of her port
"shutters were jammed; indeed, from the time the 'Hartford' struck
"her she did not fire a gun. Admiral Buchanan was wounded in the
"leg, and two or three of his men were killed, and five or six
"wounded.

"Our iron-clads, from their slow speed and bad steering, had some
"difficulty in getting into and maintaining their position in line as we
"passed the fort, and in the subsequent encounter with the 'Tennessee'
"from some cause were not as effective as could have been desired."

From the official reports of the Officers commanding the Monitors we learn that the "Winnebago" was struck nineteen times, three shot having penetrated the deck. The after-turret broke down completely.

The "Manhattan" was hit nine times, causing no material damage. The 15-inch carriage was injured by the recoil of the piece.

The "Chickasaw" was struck a number of times, one shot penetrated her deck.

On board of these three vessels there appear to have been no casualties.

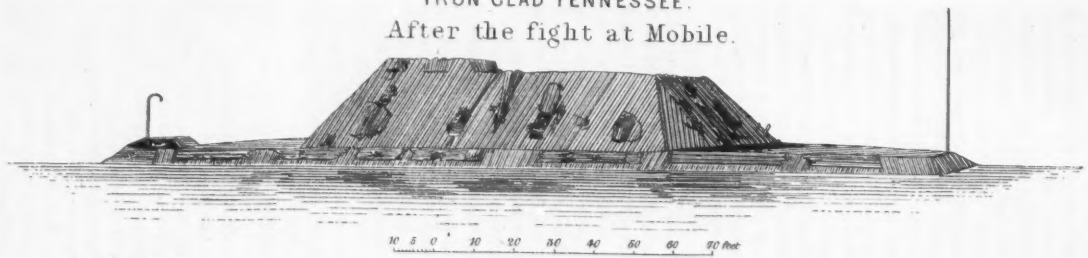
The "Tecumsech," as I have already stated, was destroyed by a torpedo, and with her were lost Captain Craven, a very accomplished and gallant Officer, and most of her crew.

In the wooden vessels the Federals lost 52 killed and 170 wounded. Most of this loss was inflicted by the guns of the "Tennessee."

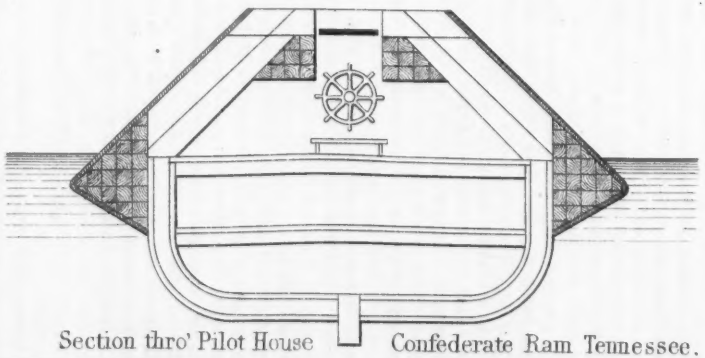
The "Tennessee" (Plate xiii) was a vessel built after the "Merrimack" system, with the addition of the knuckle or over-hang. The hull was of oak and yellow pine with iron fastenings. Length on deck 209 feet, beam 48 feet, draught of water 14 feet. The casemate was strongly built, 79 feet long, 29 feet wide inside, the sides of the vessel extending 10

IRON CLAD "TENNESSEE"

After the fight at Mobile.



x 15 Inch Shot



Section thro' Pilot House — Confederate Ram Tennessee.

J. Jobbins

feet from it at the greatest breadth of beam. The sides and extremities of the casemate were made of stout timbers and planking of pine and oak, making a total thickness of backing of 25 *inches*, upon which was placed armour plating 6 and 5 inches thick, in single plates of 2 inches and 1 inch thick. The slope of the casemate was 30°.

The "Tennessee's" armament consisted of 7-inch and 6-inch cast iron rifled guns, firing respectively wrought-iron bolts of 133lbs. with 16lbs. of powder, and similar bolts weighing 94lbs. with 12lbs. of powder, which seemed to produce but little effect on the Monitors.

It perhaps should be mentioned that the sides of the wooden ships were protected with chains, which seem in most cases to have prevented the complete penetration of shot and shell fired against them.

No shot except the 15-inch shot seems to have sent splinters into the casemate of the "Tennessee," in fact, it was the only shot which penetrated to the timber backing. Nine 11-inch solid shot struck within a space of a few square feet in the immediate vicinity of a port; the armour plating was started, bolts driven in, but none of these shot seemed to be able to get into the timber.

The 11-inch guns were fired with solid cast iron and steel shot, and 20 pounds of powder. The 15-inch guns, solid shot, cored shot, and shell, with 35, 50, and 60lbs of powder. The 100-pounder and 150-pounder rifled guns with chilled bolts, and 10lbs. and 16lbs of powder respectively.

The "Tennessee" bore no external evidences of the injury inflicted upon her hull by the ramming of the wooden ships, and had she been more manageable as a ram, and been armed with heavy smooth-bores instead of inefficient cast-iron rifle cannon of small calibres, she would, in the estimation of her captors, have made a better fight.

Her chief defects were in her exposed steering gear, and her motive power. Her engines were taken from a river steam-boat, and by much ingenious management induced to turn her screw. The shooting away of her funnel filled the gun deck with smoke, and half suffocated her crew, already stunned by the ramming of the wooden ships, and blinded by the blast of bursting shell. Could she have got clear of the corvettes, she might have stood a better chance with the Monitors, of whose service in the action the Admiral does not seem inclined to be enthusiastic, and for whom he did not wait to commence battle.

Effects of Torpedoes on Monitors.

After occupying the lower portion of Mobile Bay, the Federals lost two Monitors by torpedoes. One had a hole ten feet in diameter knocked through her forward, and the other sunk in three minutes.

The torpedo is peculiarly fatal to the monitor class of vessel. Their sides not being on an average more than 18 inches above the surface, the remaining floating power of the "Passaic" class, which are 844 ton O. M., is not according to Admiral Goldsborough's estimate more than 200 tons. In action everything is battened down, and the chances of egress from below and the gun ports of the turrets are very few. The hatches have to be lifted from below with levers, which have to be found and applied at a time of more or less panic or confusion.

The only true Monitors destroyed in battle during the war were by torpedoes, and of these three were sunk at Mobile and one at Charleston. It seemed easier to blow a hole in their bottoms with roughly constructed torpedoes than to penetrate their turrets and hulls with the ordnance necessity forced the Confederates to use.

The same want of resources which told against them so fatally in the creation of a fleet, prevented their employing a simple and efficient system of self-acting electric torpedoes.

Wilmington.

The Chart (Plate xii, fig. 5) shows Fort Fisher at the entrance of Cape Fear River, and the key to the defences of Wilmington, the port most used in the war as a depôt for blockade-running.

Fort Fisher was built entirely of sand, and its guns 46 in number were mounted *en barbette* between traverses, and in casemates. The sea-front extended in a direct line about 1,200 yards, and the land front, as it was called, 550 yards. The land along the sea-coast of the Southern States is low and sandy, and resembles in its general features the coast of Lancashire, from the mouth of the Mersey towards Southport.

The guns on Battery Buchanan, and those in depôt, were not used in the second bombardment against the fleet, and should not be included in estimating the effective armament of the defences.

The United States' Army Engineers state, that there were only 12 guns in position of any value against iron-clads, and the heaviest of these were the 10-inch columbiads, and two 8-inch cast-iron rifled guns. One was a Blakely gun (at point B), rifled with three deep grooves, and had flanged projectiles on Captain Scott's system. The Federal and Confederate reports agree in stating, that this gun was the most efficient of the armament of the fort brought into action. It was taken, marked by the enemy's shot, and stained with the blood of its cannoniers.

There was mounted on the sea-front, at the point A, an Armstrong 150-pr. shunt gun, but which, as you will see, did not bear on the iron-clads. It was amply provided with steel shell to be fired with charges of 30 lbs. of powder, and which no doubt, had they struck the side armour or turrets of the monitors, would have subjected them to a test they never yet have experienced. The gun is now mounted at the United States' Military Academy at West Point, as a trophy.

The attacking fleet, as you have seen by the chart, which is enlarged from that published with Admiral Porter's report, consisted of forty vessels divided into three divisions of wooden ships, numbered from left to right. At the head of the third division was the "New Ironsides." The four Monitors occupied a position in-shore, and in advance of the 3rd Division, and at a distance of between 1,000 and 800 yards from the land-front of Fort Fisher. There were anchored outside of the attacking fleet, three divisions of reserves, composed principally of paddle steamers, and were intended, I presume to afford

any assistance required to the vessels actively engaged. The total number of guns mounted in the fleet was 617, of which 275 were available in the bombardment:—"The contrast between the two "armaments is striking," says General Abbott, of the United States' Engineers, "and shows that without mortar fire, or heavy iron case-"mates, the land guns had little chance of success."

"We expended," says Admiral Porter, "50,000 shells, and have as "much more on hand. All the guns facing the ships are dismounted "or injured, so they could not be used, or the muzzles were filled up "with sand or earth, which rendered them useless. I only saw two "that were not rendered useless. I believe we have burst all the "rifled guns left in the fleets, and I think the reputation of these guns "(Parrot's) is now about ruined."

The Monitors were all struck several times without receiving serious injury, except in one or two cases to their decks. On board of the "Saugus," one of the 15-inch guns burst, but only one man was wounded. The turret was not injured, and the firing was continued with the remaining gun. The "Mohopac" also burst her 15-inch gun. The piece went a little more than four feet from the muzzle, that is, a few inches within the turret, doing no injury to the latter, or to the men inside of it. I think these experiences are valuable. First, they show us that 15-inch guns do sometimes burst like all other guns; and, secondly, that the bursting of a gun within a turret has not such a terrible result as the opponents of Captain Coles's system would have us believe.

Admiral Porter's Opinions.

Admiral Porter has written a despatch on the result of his experiences with vessels of the "Monitor" class, and upon American ironclads generally. This you will find published with the report of the Secretary of the Navy for 1865. Few men have had a larger experience in modern naval warfare than he has, and I must say, from my personal knowledge of his attainments, that I accept his opinions on subjects relating to naval affairs, with a confidence not given to any other Officer in the United States' Navy.

The Admiral, after expressing both his gratification, and almost surprise, at the good weather the "Monitors" had made in riding out a gale at their anchors off Wilmington, goes on to speak thus of the "Monadnock:"—

"She is certainly a most perfect success, so far as the hull and "machinery are concerned, and is only defective in some minor details, "which, in the building of these vessels, require the superintendence "of a thorough seaman, and a practical and ingenious man."

Of the other Monitors he says:—

"These vessels have laid for five days under fire from Fort Fisher, "anchored less than 800 yards off; and though fired at a great deal, "they were seldom hit, and received no injury. Compared with the "'Ironsides,' their fire is very slow, and not at all calculated to silence

"heavy batteries, which require a rapid and continuous fire to drive "men from the guns, but they are famous coadjutors in a fight, and "put in the heavy blows, which tell on casemates and bomb-proofs. "The smaller class of monitors, as at present constructed, will "always require a steamer to tow them, and to take care of them. . . "I do not know what their real durability is, or would be, in a con- "tinuous fire against their turrets. Solid 11-inch or 200-pounder "rifle shot are apt to break something where they strike, and I should "be much better satisfied myself to be behind wooden bulwarks, and "take what comes, than to be shut up in an iron turret, not knowing "whether it is properly constructed. This, though, is the prejudice of "a sailor, and should have no weight whatever.

"I have only to remark that the principle is a good one, if the "vessels are all built like the 'Monadnock.' The fire of these vessels "continued with such vessels as the 'New Ironsides,' and heavy frigates "is very effective, particularly against heavy-plated vessels, bomb- "proofs, and stone and brick walls. I have never yet seen a vessel "that came up to my ideas of what is required for offensive operations "as much as the 'Ironsides.' She combines very many good qualities. "The most important is the comfort with which the people on board "of her live, though she would be no match for the 'Monadnock' in a "fight, the latter having more speed."

I must remind you that the "Ironsides" was a partially armoured broadside vessel, carrying fourteen 11-inch 7½-ton guns, and two 150-pounder Parrot rifles. Her speed was, I believe, about seven knots, that of the "Monadnock" about ten knots.

Present Naval Forces of the United States.

The American Navy at present consists of 278 vessels, mounting 2,351 guns. Of these, 55 are iron-clad Monitors. The American Congress has authorized the selling of a number of these latter, which will leave not more than 20 Monitors in the Service of the following classes:—

	Tonnage. O. M.	Guns.		Thickness of Turret.
		Number.	Calibre.	
Dictator	3033	2	20 inch	15 inches.
Kalamazoo ..	3200	4	15 „	15 „
Monadnock ..	1564	4	15 „	12 „
Canonicus ..	1034	2	15 „	11 „
Passaic	844	2	15 & 11 „	11 „

None of these vessels are at present in commission.

Writing in 1864, and previous to the completion of the monitors of

the "Kalamazoo" class, the Chief of the Bureau of Construction says:—

"For the protection of our coast and harbours we are probably well "prepared, but we have only three vessels that can pretend to cope "with the sea-going iron-clad vessels of European nations, and these "have not yet been tried. It is a problem to be yet resolved, whether "a large steam-vessel with her deck a foot or two above water and "without sails, can be effective, and use her guns as a cruizing ship.

"Until such time as it becomes the policy of the Government to "build iron-armoured vessels for sea service, and whenever com-"menced, it will require some years to have them in sufficient num-"bers to keep an enemy from our coast; we must have recourse to "plating wooden vessels, of which the first cost is less, though it is "certain to be more expensive in the end.

"Until we have armoured sea-going ships, we must give up the "expectation of engaging our foes on the ocean, and must limit our "operations to attacks on their commerce."

Mr. Lenthal, the Chief Constructor, and Mr. Isherwood, the Engineer-in-Chief of the American Navy, in a joint communication addressed to the Navy Department in March, 1862, and which they submitted as an expression of their opinions to the "Committee on the Conduct of the War," in March, 1865, and to which opinions they state they still adhere, advised the building of wooden armour-clad vessels, with twin screws, fighting their guns in turrets revolving on their circumferences, instead of on a central spindle. These gentlemen conclude their letter thus,—

"Harbour defences are indeed valuable adjuncts, and should not be "neglected, but they cannot constitute a Navy, or perform its proper "functions.

"If ever assailed by a powerful maritime foe, we shall find, if ready, "how much better it is to fight at the threshold than at the hearth-"stone."

The Monitors of the "Monadock" and "Kalamazoo" classes, represent to some extent the suggestions of Mr. Lenthal and Mr. Isherwood. These vessels are made of wood, and have no overhang; their turrets, however, are of unbacked laminated armour, and are mounted on Mr. Ericsson's central spindle system, and not on Captain Coles' system, as at first advised by these gentlemen.

It needs, however, no great penetration to divine the future naval policy of the United States. It is to hold its coast and harbours safe from blockade and attack, by the creation of a numerous fleet of powerful monitors and torpedo boats; one of these latter of 116 tons, has already found its way into the Navy List. With the coast secure and the harbours open, the ocean is to be covered with a swarm of swift cruizers, and letters of marque. Hence the production of the "Wampanoag" for the cruizer, and the "Puritan" for the protector.

If the "Wampanoag" is not an "Alabama," *par excellence*, it is because she was built under an erroneous conception of what such a ship ought to be.

American Ordnance.

I regret that in disposing of the vast amount of material at hand, and not being skilled in the process of literary digestion, I have left myself no time to enter into the details of the experiences of the war with the ordnance employed. Captain Fox, then Assistant Secretary of the Navy, in his evidence before "the Committee on the Conduct of the War," states distinctly (I quote his own words), "*We have got* "*to come to wrought-iron and steel guns, and abandon cast-iron.*" I need hardly say to you, that Captain Fox was not only in a position to form a correct judgment by sifting the opinions of others, but his previous education as an Officer, and his attainments as a practical and scientific man, make his opinions worthy of serious consideration, and I think we may safely conclude, that the cast-iron guns of the American Navy are a temporary substitute for guns of steel or wrought-iron, or both combined.

Some experiments have been instituted at Washington by the Army Engineer Bureau, to ascertain the value of the ricochet fire of the 15-inch gun. The results of these experiments are given with great minuteness by General Abbot, in a paper published by authority of the Secretary of War, and which is re-published in a very useful and interesting work by the former, entitled "Siege Artillery in the Campaigns in Virginia." His general conclusions are given in a tabulated form, which clearly establish the fact, that even with this calibre, ricocheted fire is worthless against iron-clads. Hence efforts have been made to substitute for the heavy smooth-bore gun, a 12-inch rifle gun cast in the same mould and in the usual Rodman manner. The projectiles have grooves cut in them, so that they are locked with the gun, and cannot get out without rotating.

The bore of the gun, of course, is ribbed to correspond with the grooves in the shot, and, I believe, the ribs are three in number. This gun has been fired 400 times with charges of 45 and 55 pounds of powder. As the gun weighs 23 tons, and the shot 600 pounds, the charge of powder is light in comparison with that of the Woolwich 600-pounder, which is, I believe, 70lbs., and more notably to that of guns manufactured of Firth's steel, which have fired 500-pound shot with charges of 60lbs of powder, the gun weighing but 16 and 18 tons.

In 1864, there were three of these 12-inch rifle guns cast for experiment by the Navy. I have not seen any published results of those trials. After the painful experiences of that service with cast-iron rifle guns, its officers will be cautious in again committing themselves to that system.

Hence for fighting armoured vessels a 13-inch solid shot smooth-bore gun, weighing about 15 tons, and firing a 280-pound shot with fifty pounds of powder, and a 130-pounder 10-inch gun weighing about 7½ tons, and fired with 30 pounds of powder, have been introduced into the Service in lieu of the 15-inch and 11-inch shell guns.

The present charges for the 15-inch Navy gun, as authorized by the United States' Ordnance Instructions for 1866 are as follows: For dis-

tant firing 50lbs., for ordinary firing 35lbs. At close quarters against iron-clads 60lbs. and a solid shot of cast-iron (worked and poured in a peculiar manner), *may* be fired for 20 rounds.

The 15-inch shell weighs	330lbs.
And carries a bursting charge of	13 „
The *cored* shot weighs	400 „
The solid shot weighs	452 „

The two 15-inch guns which burst at Wilmington were fired with 35lbs of powder. As the instructions for inspecting the vents of all guns during and after firing is religiously observed, we have no data by which to judge of the actual endurance of these guns, for whenever there is an indication at the vent of approaching dissolution, the gun is at once withdrawn from service.

We have seen in the cases of the "Atlanta" and "Tennessee" that the 15-inch shot did not pass through the backing of their slanting but imperfect armour, although the distances were in neither case more than 300 yards, and in the latter the charge was 60lbs. There can be no doubt that a similar shot upon the "Manhattan's" turret would have knocked it entirely off its centre.

Conclusion.

In conclusion, I have only to ask you not to understand, from anything I have read you, that I disapprove of the "Monitor" system as a system. As faulty as many of the American "Monitors" may be in the details of their construction, the principle is a sound one at its core, and for transporting heavy guns in shallow water, and fighting them under such circumstances, I can conceive of no vessels which would surpass them in efficiency and invulnerability, *provided* they were built with solid armour, wood backing, and Captain Coles's turrets.

Looking to the experiences of the American War, I think we must admit that, whenever the Monitors have more nearly resembled Captain Coles's system, their performances have been best—at sea and in battle, as in the "Monadnock;" and, on the other hand, where the difference between the two systems has been *greater*, as in the case of the "Weehawken," the defects have been most palpable. Although the Monitors may not be very habitable vessels, still the evidence of the Chief of the Bureau of Medicine and Surgery is conclusive as to their healthfulness. On board of the "Montauk," for a period of 164 days prior to May, 1865, there was but one case of sickness—yet in warm weather the heat is very great in the turret and stoke hole—to be attributed to the perfect ventilation by artificial means.

If I may judge from the expression of the official opinions of the Officers of the American Navy, I would say that the tendency is not to depend solely on turret ships in the composition of the fleet, but to have such ships as "coadjutors in a fight," as Admiral Porter says, to put in the occasional heavy blows, with the more rapid fire of the

lighter guns of the broadside vessels, even if those vessels can be but partially protected with armour chains or other devices.

I trust that the facts and opinions I have had the honour of placing before you this evening, have been of sufficient interest to repay you for the trouble you have been to in coming here to listen to the reading of this paper. If the conclusions which I venture to draw are erroneous, I need only say I am anxious for correction.

I take it they may be thus condensed:—

1st. Fixed fortifications without obstructions are powerless under ordinary circumstances, to prevent the passage of a swift and powerful fleet.

2nd. Floating batteries to fight such a fleet, must be quicker in turning, of light draught, and unexceptionable rams.

3rd. The placing of one or two floating batteries in a harbour, and depending on them to destroy a fleet, which is capable of passing a regularly constructed fort, is but an invitation to disaster, and a delusion which should be dispelled by the fate of the "Tennessee" at Mobile. Under similar circumstances it would perhaps be safer to rely on a fleet of nimble musquitoes, like the "Staunch," with their 300-pounder stings, than upon an invulnerable, but sluggish iron-clad battery.

4th. The power of an enemy's fleet to inflict injury, can only be completely neutralized by a fleet of similar magnitude, and capable of making counter demonstrations. All temporary substitutes for such a fleet cannot keep your coast free from blockade, your harbours secure from the danger of surprise, or even an enemy from landing on your shores.

5th. A free people in arms, although deprived of many of the necessities of war, may form a formidable Army to repel invasion, but the creation of a fleet is the development of years of patient experience and careful organization, the offspring of a prudent foresight, rather than of the exigencies of unexpected war.

6th. It is wiser to concentrate the resources of a country on the fortifications of the principal forts and arsenals, so as to secure them against capture, than to expend the same resources on many comparatively unimportant points, which from their isolation and weakness invite attack, and afford to an enemy the opportunities of obtaining cheap victories.

7th. Guns mounted *en barbette* in open earthworks, cannot keep down the fire of a well handled and numerous fleet, or prevent its passage. To fight such batteries, we require a rapid and concentrated fire of broadside vessels to silence an enemy's fire, while either making the passage of such batteries as at New Orleans, Vicksburg, and Mobile, or to enable the turret vessels, with their slow and precise fire, to dismount and destroy an enemy's most formidable guns and defences, so that the work may be carried by assault, as at Wilmington.

8th. Monitors like those at Charleston cannot reduce a fortification like Fort Sumter, with smooth-bore guns, even of 15-inch calibre. Because to make these guns efficient against such fortifications, they must approach within ranges at which such Monitors cease to be suffi-

ciently invulnerable to supersede siege batteries of rifle guns, like those employed on the land, and with which General Gilmore reduced the same work to a ruin at distances of from 4,000 to 3,000 yards. Nor can Monitors, so deficient of speed as those employed at Charleston, run the batteries of a fort, unless they are attended by broadside vessels, to keep down the enemy's fire with shell, grape, and shrapnel, as was done at Mobile. No Monitor has yet been subjected to the fire of a gun as powerful as the 9-inch Woolwich gun.

9th. When it is possible to do so, the scene of action should be removed from your shores, and the enemy's fleet attacked before it gets within gun-shot of your defences. To do this at this day, an iron-clad sea-going fleet is absolutely necessary, equal in all respects to that of your enemy. Such a fleet this country can obtain sooner than any other, for you have the money, the iron, the skill, and the labour to build such a fleet, and if I have read aright the history of your Navy, the men to fight it intelligently and courageously.

10th. And lastly. As it is quite evident that no European power has on one hand an armoured fleet of sufficiently light draught to operate successfully on the American coast, and, on the other, as the Americans themselves have no sea-going iron-clads other than a few Monitors to cross the Atlantic, to make war on this side of the water, we may conclude that the hydrographic inequalities of the two continents are so many guarantees for peace: or at all events, in case of such a war, the operations at sea will be mostly conducted in wooden ships, acting as independent cruisers.

Commander W. DAWSON, R.N.: Mr. Chairman, as far as I gather from the applause which greets Captain Hamilton on his sitting down, I am sure that I do but express our united opinion that we have heard a very interesting, clear, and able paper, this evening. I have been very much struck with the exact nature of the facts and figures which Captain Hamilton has brought before us. Many of those figures, when read out from a paper, are naturally somewhat dry to listen to; but when they appear in print in our "Journal," the communication, I think, will be found one of the most able that has adorned that "Journal" for some time. Those who have read and studied carefully the official despatches to which Captain Hamilton alludes, and which are published with the Reports of the Secretary of the United States' Navy, must have been struck with the remarkable rise and progress of that Navy from almost nothing, from a very low state of organization, without ships, without guns, without men. Suddenly, the whole force was created; and we must not be surprised if a force so created, was not very perfect in the constructive department. I do not think myself, from what we have heard from Captain Hamilton to-night, that we have much to learn in the constructive department, from the—I might almost say *late*—United States' Navy, for, according to Captain Hamilton, it has almost passed out of existence. But it was wonderful to me on reading those despatches to see how much was done with such imperfect tools. It reflects very great credit on the Officers of the United States' Navy and their seamen, that they were able to effect so much with such ships and such guns. I think the secret of it was, that they had not that fear of responsibility which naval men in this country labour under, whose actions, if not altogether successful, have to pass through a very severe criticism at home. Captain Hamilton did not tell us that when the Flag Officer Dupont was beaten back from Charleston, he received a telegram from the President to go in again, and wait for further orders. Fortunately, he was not in a condition to do so; but that spirit of determination at head-quarters that something

should be done at any cost, was, I think, the great cause why the Officers felt themselves untrammelled by responsibility as to what their superiors would think, provided they fought the enemy. I wish to bring to your notice one point with reference to three of those plans before us. Captain Hamilton told us with regard to the plan of New Orleans, and I quite agree with him, that if there be a clear channel through which ships—be they of wood or iron, and propelled by steam—can get past, no forts in the world would ever stop a determined enemy, provided he can get to a point of safety beyond those forts, and provided there is a sufficient object to be attained by passing them. At New Orleans there was a raft formed with chains and vessels, moored across the channel; but it was so imperfectly constructed, that when the United States' Officers boarded that raft, they had simply to cast off the chains, and then there was a passage created, through which the vessels passed. In the case of Mobile we observe the same thing. There was an obstruction across a great part of the channel; but there was an opening within 200 yards of Fort Morgan, and in consequence of that, the ships were able to pass through. There was one torpedo, unfortunately, in the way, which sent the "Tecumseh," an iron-clad, to the bottom, with the loss of her crew, except some eight or ten Officers and men. Now, if you look at the plan of Charleston, why was it, I ask, that for a course of three years, a fleet was anchored off there, which was not able to get in, to pass those batteries and turn them? why did it remain outside? It was simply, at least I can only explain it on that ground, because that channel was obstructed, not only at the entrance but above Fort Sumter. It was obstructed carefully, not only by those ropes to which Captain Hamilton has alluded, but also in a very great degree by torpedoes. When Admiral Dupont went in there, in April, 1863, the "Ironsides" anchored over a torpedo, about 1,000 yards off Fort Wagner.

Captain HAMILTON: About 3,000 yards from Fort Sumter.

Commander DAWSON: She was anchored over a torpedo, which at the right moment was to have been fired by electricity, but which failed to go off, and she was saved. If all the torpedoes were like that, there was not much to fear from them. But according to these despatches, the Americans, in the course of the war, lost 26 vessels, besides 8 or 9 injured, by torpedoes; in fact, they lost more from torpedoes than from any other cause during the whole course of the war. The channel at Charleston was obstructed by torpedoes both inside the harbour and at the entrance. They might have been imperfect, but they did their work well by keeping the enemy out. They not only destroyed the "Honsatonic" and "Patapsco," but after the place was actually captured, three or four Federal vessels were severely injured by these torpedoes. It is only by obstructing the water-way in some way or other, that is to say, by torpedoes, or passive obstructions, that you can prevent an enemy's ship passing forts and getting into a point of safety beyond, provided she has a sufficient object before her to tempt her to do so. I will not touch further upon the point of torpedoes, except to say that their utility in obstructing a channel appears to me to come out very strongly in these three plans of forts; for there seems no reason why the Federals should not have got into the other places, and should not have got into Charleston were it not on account of the torpedoes and other obstructions in the passage. It is true that in passing forts, the Federals very often lost their ships, as at Fort Pittsburg: but then they had a sufficient object to attain, and the loss of a few ships was of no consequence compared with the great results to be achieved in putting an end to the war.

Rear-Admiral SIR FREDERICK NICOLSON, Bart.: I am sure that we all agree with the remarks of Captain Dawson, that it is very rarely that we hear in this theatre a lecture which conveys a greater amount of information. It is information of that valuable class which we so much require; not merely experiments made at Shoeburyness or at other places, but the results of actual warfare. There is one point brought out by Captain Hamilton, to which I wish for one moment to direct your attention. I cannot help expressing my regret that we did not hear this paper before the two projects of moveable circular forts, and circular ships of war were brought before us on previous evenings. The point is, the unmanageable character of some of the American vessels from want of speed, or, in other words, from want of power in their engines. I do hope that inventors, when they ask seamen to adopt these extraordinarily shaped floating bodies we have seen models of here, will recollect

that in a narrow channel, in fact in any channel where there is a strong tide, vessels of that kind must be unmanageable; and that, unless we have a sufficient speed, I might also add, unless the vessels are of moderate size as to length, such vessels are unhandy. I think we can all understand, at least all seamen can thoroughly understand, that a Commander going into a narrow channel with four or five unmanageable vessels, cannot be in a very comfortable position. I cannot help thinking that the handiness of vessels is apt to be lost sight of in the attempt to make them invulnerable, and also to carry enormous weights, whether of armour-plating or of guns, thus obliging the constructor to make them of these peculiar shapes. I think Captain Hamilton only confirms us in what most of us know respecting the rare ability of Captain Coles. I remember having a conversation with Captain Coles, when some of the failures of the turrets were first known in this country; and I remember his pointing out to me, as it has been pointed out to-night, that his turret did not revolve on the spindle, but upon the circumference, and that jamming could not happen with his turret. I was cognisant of his first turret on board the "Trusty," when it was severely tested, and I was much struck with the fact, that though that turret was very much battered, it was perfectly manageable and in perfect working order at the end of the experiments. I am sure we are all glad to see Captain Hamilton here to-night, and as he says there are other points which he wished to bring before us, I only hope we shall have the pleasure of meeting him here again on another occasion.

Captain MAURY (late C. S. Navy): I merely wish to avail myself of this opportunity to bear my testimony to the exceedingly valuable and interesting paper that Captain Hamilton has given us. He has spoken of events with which I am very familiar. I was, as it were, mixed up with those affairs, in fact, at the beginning of them, very much so; and I can bear testimony to the accuracy with which he has given his statements and figures, and the accuracy with which he has gone through all the details. There is one point upon which I should like to put in a little caveat. On one side we had everything to improvise. We had nothing. I went to Richmond when the "Merrimac" was at the bottom of Norfolk harbour; and one of the first things we did, was to raise that ship. All the powder that was in the Confederacy, except blasting powder, consisted of such as had been taken out of the magazine by a very few Officers, whilst in the north one night. A short time before the battle of Manasses was fought, I had a note from General Lee to say that unless I could furnish him with percussion caps, he should have to withdraw our army from the field. We had 40,000 percussion caps, and the machines with which the caps were made that fought that battle, were manufactured between the 18th of April and the day of the battle—the machines and the caps both. So it appears to me that the marvel is that, with the naval resources on the one side and the total absence of them on the other, though a great deal was done, yet a great deal more might have been done. That more was not done, was not because of torpedoes, but because of the fear of torpedoes. The only place in the whole Confederacy that was properly defended by torpedoes was Richmond. We had no wire; we had no insulated wire; we had not even the electric instruments to use for setting off the torpedoes. I had despaired of getting anything; but fortune turned in our favour. An attempt had been made on the Federal side to lay a submarine cable in Chesapeake Bay. It parted; ten miles of it was within our lines, and with that wire the James River was defended. There were no torpedoes at Wilmington. You recollect that that first attack, made by Admiral Porter and General Butler, failed, on the plea by Admiral Porter, that he dared not enter for fear of torpedoes. There were no torpedoes there. There were not many torpedoes in Charleston; at least, if there were, they were mechanical torpedoes.

Commander DAWSON: They were principally mechanical torpedoes at Charleston.

Captain MAURY: They had no means of testing those torpedoes at Charleston, to know whether they were or were not serviceable. The James River torpedoes were tested every day; they blew up vessels that came within distance. The last one that was blown up, was the Commodore Jones. At Mobile they had a great number of mechanical torpedoes. I afterwards saw one of the Officers who was there, and he told me that he used to hear them going off in the night; the fish would strike against

them, or the swell would wash them against the shore, or a log would strike against them; so that when he put down those torpedoes, he did not know whether they would be there when wanted. Again, I desire to add my thanks to Captain Hamilton, and my admiration for the very clear, graceful, and perspicuous manner in which he has given us this account.

Commander DAWSON: I wish to ask one question. I shall be obliged by your explaining how the "Keokuk's" turrets were worked?

Captain MAURY: I do not think they were turrets, they did not revolve.

Commander DAWSON: They were fixed towers?

Captain MAURY: Yes.

Captain HAMILTON: Perhaps I could explain the reason why the Federal fleet did not pass into Charleston. I think it was purely a military reason. The defences on Sullivan's Island were perfectly untouched to the last, there was never a gun dismounted. That whole island, which is about five miles long, was one fortification. Even after the Federals occupied Morris Island, and Fort Sumter was reduced to a ruin, though there was a fort quarried out of the ruin and 10-inch columbiads mounted on it, yet if the Federal fleet had passed those slight obstructions it would have had to encounter the whole of the line of interior defences, which, during the time it took General Gilmore to destroy Fort Sumter, had been made stronger than the exterior line. Even if the Federals had got off the city, the whole of that side of the city was fortified; they could simply have got into the harbour, and could have done no more to the city than General Gilmore was doing every day.

Commander DAWSON: They could have gone into Ashley river had it not been obstructed?

Captain HAMILTON: They could not have gone into Ashley river, it was fortified. General Ripley is here who defended Charleston, he could tell you as to that.

The CHAIRMAN: Perhaps General Ripley would explain.

General RIPLEY: I did not intend to say anything with regard to the defences of Charleston, but the question has arisen why the Federal fleet did not pass. I think Captain Hamilton has given the correct reason. We had very few torpedoes at first. The torpedo to which he referred some little time back which the "New Ironsides" lay over, was for some time the only one down. There were reports given out of a great many torpedoes, in fact flags were placed about the harbour, and particular cautions were given to all vessels to pass through certain channels, simply, not to avoid torpedoes, but to avoid where they ought to have been, where we should like to have had them, if we had possessed the materials to make them. Afterwards we got down a good many stationary torpedoes, and after we had received a supply of insulated wire, a good many electric torpedoes were put down. But the reason why the enemy did not pass at Charleston was, that there was no rest for them; if they had passed the outer batteries they would have come within another circle of fire, which was formed by the north-western face of Fort Sumter, Fort Johnson, Castle Pinckney, and Fort Ripley. Had they succeeded in passing these, they would have been in the centre of another circle of fire, composed of a number of batteries, placed on the wharves of the city, on the shore of James Island, and extending up both banks of the Ashley and Cooper rivers. Some of the batteries are not placed on the chart, but some of the heaviest guns we had, were on the interior batteries. We were so confident about the affair that at one time a message was sent by some prisoners who had been exchanged, that if Admiral Dahlgren would send four of his best vessels inside, they could pass the outer batteries, but if they ever got out again was quite another thing. We never heard any more of the challenge. The whole policy of the defence rested on the principle of making the outer batteries only the first crust; the farther the enemy got in the worse off would they have been. The Ashley and Cooper rivers were made so bad for a fleet to enter, with the number of batteries we had, that it was almost impossible for them to pass the city. That was one thing which they really feared more than anything else. They had information, of course, of everything that was going on. It was the guns and the number of artillerymen who had been kept constantly at work for years, and who knew every gun, that did the business. I really think that, if General Lovell at New Orleans had had the opportunity, which we had, of fortifying the banks of the river for several

miles above the forts, so that after the Federals had passed Fort Jackson and Fort St. Philip, they had been subjected to the fire of guns of such a calibre as we had, that the fleet would have been turned back. No set of forts can be expected to stop, where there is a good channel, a fleet of fast going steamers, whether iron-clad or wood, when it is done all at one rush, when it can be done at the rate of eight or ten miles an hour, and as they run past one point decreasing their range every moment, and taking advantage of their concentrated broadside to protect themselves and to fire close charges of grape from their guns. But if they find that the further they go for a number of miles, the worse it is, and that they have to keep up the fight for an hour or so, the probability is that they will not attempt to pass the outside. That was the system of defence which was adopted by General Beauregard at Charleston. I had the honour of serving as second in command throughout the whole of the siege, and that was the principle we adopted, to make the interior as strong as the exterior. The heaviest guns we had were mounted in the city; they were 600-pounders. There were two there, besides a number of guns which had been improvised into 10-inch rifles, capable of throwing shot of 250lbs. They answered exceedingly well; they were not the best guns that could be made, but they were the best we could get. We never struck a "Monitor" with any shot over 120lb. except once, then a rifled ball weighing 250lb. from a 10-inch gun struck one of them upon the pilot-house and shattered it all to pieces. It was the last time that we had any encounter with the "Monitors," for after they found that we had guns of this calibre, they always kept out of the way. I believe that is the answer to the point that has been put.

Commander DAWSON: With reference to one point, when you say you had no torpedoes, I understood you to say that you had one at Admiral Dupont's attack?

General RIPLEY: We had one at Admiral Dupont's attack.

Commander DAWSON: Afterwards?—In 1864?

General RIPLEY: We laid them down at different times. We obtained a quantity of insulating wire.

Commander DAWSON: But you had a quantity of torpedoes down, and a quantity ready to put down in 1864?

General RIPLEY: We had a good many down, and many ready to put down, but they were not of the best construction.

The CHAIRMAN: Have you any remarks that you wish to make, Captain Hamilton?

Captain HAMILTON: I have only to thank you for the very kind manner in which you have been pleased to receive the paper I have had the honour to read. Its preparation has not been a painless task. The mere references to places and persons have revived the memory of aspirations now relinquished, and have brought back to me the faces of dead men once dear to me, and who fell under both flags, as men who speak English always fight, with their whole hearts, for the cause they think just.

The CHAIRMAN: It wanted, certainly, not these few words which we have heard just now to increase our admiration of the instructive lecture which we have had from Captain Hamilton. I think we may congratulate ourselves on having heard one of the most interesting lectures that has been given here this session, and we may also say that the manner in which it has been delivered, has produced a very great impression upon us. If there was anything wanting to increase the interest of this lecture to us, it will be the recollection, that these gentlemen, who fought on both sides in this war, were nationally connected with ourselves. Here, luckily, in this Institution we have nothing to do with politics, but we can never shut our eyes to the high qualities which were shown in this contest on both sides. It would be difficult to find a contest where on both sides, whatever the motives were, the contest was carried on with an ability and a patriotism which is worthy of our admiration, our respect, and our warm feelings, whatever we may think of the politics on either side. We cannot but admire the talent, the bravery, and their devotion to the cause which each side espoused, believing that they were acting for the welfare of their country. We have to thank most sincerely not only Captain Hamilton but General Ripley and the other gentlemen who have favoured us with their remarks. I will now introduce Captain Colomb, who will explain Lord Caithness's gravitating compass and Mr. Nunn's apparatus for lighting the compass at night.

THE EARL OF CAITHNESS'S GRAVITATING COMPASS AND NUNN'S IMPROVED BINNACLE LIGHTS.

Commander COLOMB, R.N.: Mr. Nunn has asked me to explain the compass for him, as he is content to confine himself to producing good things, leaving the description to others. Lord Caithness has taken it, that while we are paying great attention to the scientific adjustment of compasses, we are losing sight, to a certain extent, of a matter which is immediately under our hands. His idea is, that the oscillation of the card in bad weather throws out the course of a ship considerably, and that the side movement of the points, renders steering very difficult; and we know this as a familiar fact, that in heavy weather for instance, in running before the wind we do sometimes make courses so different from the dead reckoning, that they are set down to the presence of extraordinary currents, which sometimes take us in directions we do not expect. His Lordship has accordingly devised an arrangement to get rid of a great deal of this oscillation, if not the whole of it. At present, as is well known, the compass is hung upon jimbals. The jimbal is really equivalent to hanging a weight at the end of a long lever, the curve of one jimbal forming the length of that lever. The consequence is, that any vibration on the deck of a ship is transferred, in an accelerated degree, to the bowl of the compass, and there is always more or less tremulous motion. He proposes to fit the compass, instead, in a ball and socket joint, the bowl being counterbalanced by a heavy weight. (Fig. 1.) You thus have the bowl of the compass placed on a solid block, which forms part of the ship and has no vibration except that which is in the ship itself. When a compass hung in this manner was tried, as it has been, against those hung in the ordinary way, the difference was very remarkable; there was no perceptible oscillation of the compass in the heaviest weather, whereas, in the compass which is jimballed, there is a very considerable oscillation. The weight is below, and there is room enough in the base of the binnacle for the roll of the ship to 35 or 40 degrees.

Mr. Nunn has also taken up another department, viz., the lighting of the compass; and this is also a most important matter, as we all know, because very often where the compass is badly lighted, the man steering loses the points, makes mistakes, and does not steer his proper course. Mr. Nunn has invented the lamp now before you. (Fig. 1.) In the ordinary way, the lamps are placed at the side, and they throw the lights sideways on to the compass, and never give complete illumination. In this one, the light is placed at the top, in a sort of parabola-reflector; the light is thrown down on the card, but gives no light outside the binnacle; the oil vessel, also, being hung upon jimbals, there is no spilling of oil, and this is not an unimportant matter on board a man-of-war, because we know that there are under the present system almost always permanent little clots of oil near the bin-

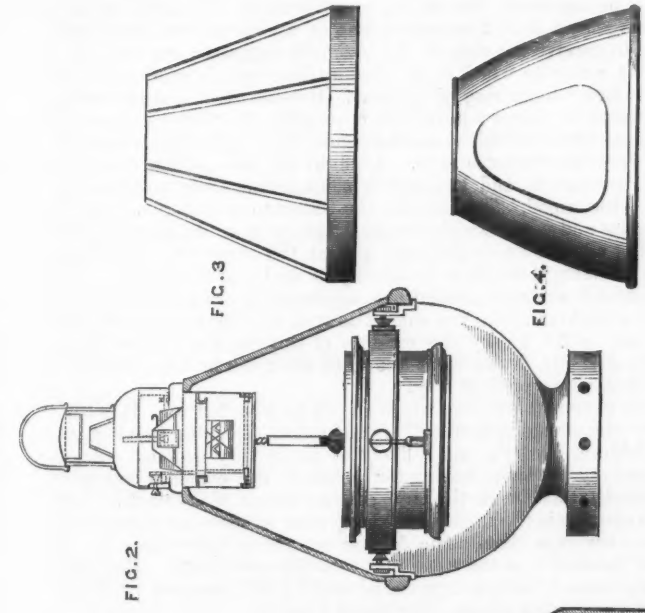


FIG. 3

FIG. 4.

FIG. 2.

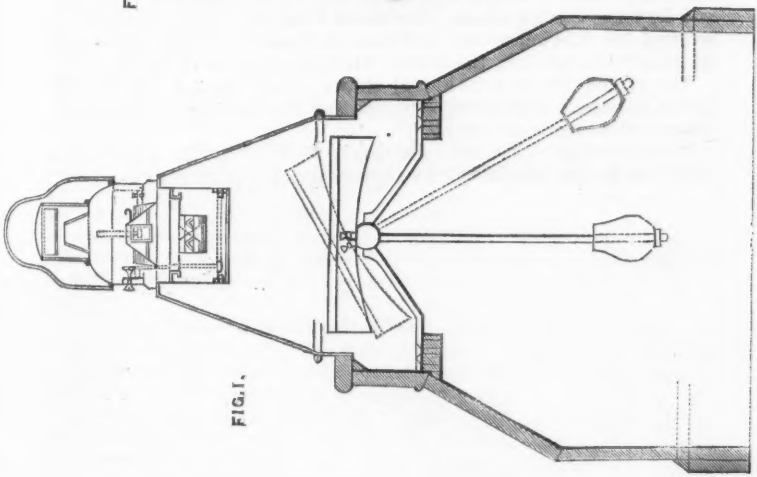


FIG. 1.

nacle, from the oil spilt from the rolling of the ship. He has also made an arrangement for taking cross bearings by night at sea. This arrangement (Fig. 2) consists, first, of a copper bowl fitted with brackets to receive the ring of the Azimuth Compass; on the top of the bowl is a ring to which is attached a tripod having another ring at the top to fit the outer ring of the lamp. Outside the tripod and fitting over the lamp is placed a hexagonal cover (Fig. 3), with six panes of glass, again outside of this is a metal shade (Fig. 4), having an aperture in it to show the compass card. At night the two outside covers or shades are removed, and the lamp remains in the same position supported by the tripod. This enables the Officer to get at the sights of the compass and work it with the same facility as in the day time, the light being all thrown on the card, and at the same time being confined in the lamp there is no possibility of its being blown out. This improvement is a most important one, as it enables you to take accurate bearings at night; and this you cannot do at all with the ordinary system. It was one called for by the masters of ships in the Channel Fleet. I described to Mr. Nunn what the want was; and he has fulfilled it, I think, in a very excellent way.

There is yet one other point which should be adverted to. It is what is called "the course indicating" arrangement. It is due to a suggestion of Admiral Ryder's, and is likely to prove very useful. A band, illuminated by the lamp, having the points of the compass engrossed on it, travels round inside the lamp case by means of a detaching key. A single opening in the front of the lamp case, exposes one point and no more, to view at a time. The Master on giving the course to the Officer of the watch, at the same time sets this instrument. Supposing the course were E.N.E., he turns the key till E.N.E. appears "E.N.E.," and he takes the key away. It remains a register of the course to be referred to; it is impossible that there can be any mistake afterwards, as nobody can touch it, the Master having possession of the key.

The sketch before you (Fig 1) shows you a binnacle fitted with Lord Caithness's gravitating compass, and Nunn's improved light and course-indicating arrangement.

The CHAIRMAN: We return our thanks to Mr. Nunn for what he has done, and to Captain Colomb for explaining the apparatus to us.

LECTURE.

Friday, April 24th, 1868.

MAJOR-GENERAL THE HON. JAMES LINDSAY, Vice-President, in the Chair.

COOKING FOR TROOPS.

A Lecture prepared by Commander FREDERICK WARREN, R.N., and read by the Secretary.

SOME apology is necessary for a Naval Officer taking upon himself the reading of a paper under such a title. It should rather have been a "system of cooking for large bodies of men with economy in food and "fuel"—but as the system has been adopted into the Army, the title it is hoped will not appear presumptuous. It was originally intended that this paper should have included some remarks on "Cooking for Troops in the Field," but circumstances have obliged its being limited to cooking in barracks, and here I think I cannot do better than quote from a pamphlet that has been written on my cooking apparatus.

"In introducing a new cooking apparatus, which claims perfect novelty of invention, and introduces a new system of cooking, combining great economy of food with an extraordinary saving of fuel, and which, after long-continued and most careful trials at Aldershot, has received the unqualified approval of the authorities, some few words explanatory of its construction and capabilities are necessary.

"First, as to the new system of cooking. It has long been an admitted fact, that a large amount of the nutritious matter contained in food is lost in the ordinary process of cooking, either by roasting or boiling.

"To avoid this waste, Captain Warren invented, two years ago, an apparatus of simple construction, which not only prevented loss, but at the same time attained the desirable result in the culinary art, of preserving to every kind of meat its own flavour.

"To effect a revolution in the art of cooking may at first sight appear difficult; but when it is stated that by the new system, the viands are cooked without coming into immediate contact either with water, steam, or fire, something is asserted which invites attention to the subject.

"The meat is put into an inner chamber, the outer case of which is heated by steam, or water kept at boiling point, and is cooked entirely in its own vapour. None of its nutritious properties are allowed to escape, nor one particle to be wasted.

"It is well known that meat, cooked by roasting or boiling, loses a large portion both of its bulk and weight, and also some of its most nutritive qualities. Therefore an invention which, after repeated trials, is proved to be capable of avoiding these defects, and of cooking perfectly, must necessarily have a claim to public approbation.

"On the 28th of April, 1865, this invention was severely tested in the kitchen of the Cambridge Barracks at Portsmouth, under the superintendence of the master cook of the 26th Regiment, and in presence of Major-General Lord William Paulet, K.C.B., and the Officers of the Staff. The following is the substance of the result of the trial:—

"The rations of fifty-six men were placed in a vessel made of block tin on Warren's plan, and at the same time rations for fifty-five men were put into a boiler which was at hand.—Time 8·45 a.m.

"Six pounds of meat were also placed at the same time in two smaller tin vessels, fitting into ordinary saucepans, on the same principle as the boiler, and cooked on the kitchen grate, whilst 12 lb. of meat were simultaneously placed in the new baking oven.

"At 12·30, the rations above mentioned were taken out of the respective apparatus in which they had been cooked, and were served to the troops.

"On testing the rations that had been boiled, there was a marked superiority in those cooked in Captain Warren's apparatus. The soup was of a decidedly richer flavour, and the meat more moist and tender than that cooked in the Government boiler.

"As regards the comparison of the baked rations, the superiority rested with those cooked in Captain Warren's pots. On comparing the weight of the rations when removed from the respective baking apparatus, the result was as follows:—12 lbs. from the baking oven, were reduced to 8 lbs. 2 ozs.; 12 lbs. cooked in two pots of Captain Warren's, each holding 6 lbs., were reduced to 8 lbs. 10 ozs.—being a gain of 8 ozs. in 12 lbs.

"The meat from Captain Warren's pots was better flavoured, more tender, and the gravy, which had no water in it, as was the case with the rations baked in the Government apparatus, was decidedly richer.

"Lord William Paulet satisfied himself of the above results prior to the opinion of the men being taken. On questioning the soldiers to whom the rations were served, the reply was unanimously in favour of the soup, as also of the *bouillé;* of its superiority in quality and substance over the rations cooked in the ordinary manner, there was not a dissenting opinion.

"The experiment was again tried at the same hour the following day, in the cook-house of the 6th Brigade Royal Artillery, at the Gunwharf Barracks—with this difference however, that as the Artillery prefer baking to boiling, the rations were baked in the following proportions:—weight of meat prior to cooking in either case, 15 lbs.

On being taken out, the result was as follows:—Government baking apparatus, 10 lbs. 12 ozs.; Captain Warren's apparatus, 12 lbs. 1oz.,—showing a gain in Captain Warren's apparatus of 1 lb. 5 ozs.

"Lord William Paulet was again present at the serving out, and tested the rations, when the superiority was again awarded to the rations prepared by Captain Warren's apparatus. There was an unanimous expression of preference as regards the quantity and quality of the rations. One of the baking pots was tested on the same day in the sergeants' mess of the 6th Brigade Royal Artillery, and the result met with the approval of the members.

"The report, therefore, was most favourable on Captain Warren's apparatus. Its advantages over the Government method of cooking, appear to be as follows:—

"1. No water is absorbed by the meat in the process of cooking.

"2. Gain in actual weight.

"3. The meat is prepared at a temperature of 210°, which is acknowledged should not be exceeded in preparing the most nourishing soups.

"4. Burning, scorching, over-boiling, and smoking are impossible.

"5. Dressed meat may be kept hot for a considerable time without spoiling.

"6. One set of vessels can be used for either baking or boiling.

"7. The principle might without difficulty be made applicable to cooking in the field.

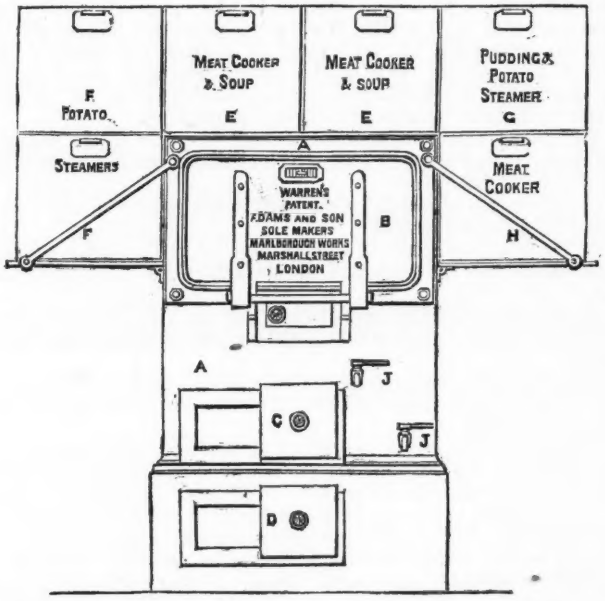
"These *preliminary trials* proved so satisfactory, that further tests were called for, and early in 1866 Captain Warren obtained permission from the Horse Guards to send to Aldershot, for trial, a *complete apparatus* adapted to the special requirements of the Army—one which would not only effect a great superiority in cooking, but also show an immense saving of fuel, besides assisting to establish a system of cooking by companies, or separate messes, so that each soldier might always depend on getting the actual rations served to him, and of having it cooked in a variety of ways. Captain Warren then patented his apparatus shown in the woodcut, which was made under his superintendence, at the works of Messrs. Adams and Sons, and put up by them in the instructional kitchen at Aldershot, and the result of the trials has convinced every one, that no cooking apparatus had ever yet been constructed, which cooked so well, or saved so much fuel. But before giving the reader the statistics of its merits, it may, perhaps be as well to describe in detail the apparatus itself.

"The apparatus consists of two parts; first, the stove proper; and, secondly, the hot air and steaming vessels in connection with it. A is the stove, constructed of wrought iron, and containing two boilers, for supplying boiling water for breakfasts, teas, and washing-up purposes, and for furnishing steam to the cooking vessels; these boilers are so constructed that the fire acts directly on the water contained in them, *no brickwork whatever*, being required either in their construction or in the fixing.

"The fire, after passing through the boilers (which by their peculiar shape form the flues), is then conducted entirely round a roaster or

oven, B, placed over the lower part of the boilers, one of which is continued up behind the back of the oven to the top of the stove. C

FIG. 1.



is the door of the furnace, which is made to slide either to right or left. D is the ash-door, which also regulates the draught into the furnace, the ash-pit being partly filled with water—the boilers are supplied with water from behind; the filling pipes forming also vents, and are furnished with whistles at the top to announce, if necessary, a deficient supply of water. J J the draw-off cocks.

"E E are two of the patent cookers, having inner linings; the bottoms of the outer cases communicate with the steam-boiler below, by means of brass ferrules and cones fitting closely, to prevent any escape of steam. The covers of the cookers are made hollow so as to contain the steam which passes up through the case of the cooker, leaving the interior free from steam, so that the meat is cooked by *hot air* only. Soup is also prepared in these cookers; the meat is placed on a perforated tray above the water or stock, *and not in it;* and the soup receives the droppings of the meat. Thus the meat loses less in weight than by the ordinary method of boiling, and the soup is improved in quality and flavour.

"F F is the potato cooker, and is fitted inside with six potato cans or pots, holding 20 lbs. each, or in all 120 lbs. The potatoes are cooked by steam from the lower boiler (the upper one being reserved for the other cookers), the whole being thoroughly done within 45 to 60 minutes, according to the kind of potato.

"H is a cooker similar to E and E, in which meat is generally cooked without soup; and on testing the weight of the meat cooked in this pot it was found, by weighing it together with the gravy that had run from it, that scarcely any appreciable loss had resulted; a joint weighing 14 lbs. not having lost 4 ounces.

"G is a steamer for steaming puddings, and is constructed to hold twelve or fourteen meat puddings, or dinners for twenty-four men. It can also be used for steaming carrots, parsnips, and other vegetables.

"The oven B is thoroughly ventilated, and will roast full rations for 22 men, including potatoes browned under the meat. It will also bake bread; 12 to 16 lbs. being thoroughly baked in two hours.

"When the apparatus is not in use, the cookers and kettles can be taken off, and placed upon a shelf, the side-plates lowered, the stove then occupies a space of 2ft. 2 in. wide, 3 ft. 7 in. high, and 1 ft. 10 in. deep.

"The apparatus as now made, is calculated to cook for 120 men, or two companies. The following statement shows how this can be done, each mess being kept separate.

Company A, consisting (say) of	60 men,	in 3 messes.
Company B,	„ 60 „	3 messes.
	Total ..	6 messes.

1st mess.	A full bake, or roast in oven, consisting of joint and potatoes under	20 men.
2nd mess.	One meat pie in oven, or a second joint and potatoes	20 men.
3rd mess.	Meat and soup in top cooker	20 men.
4th mess.	Stew	20 men.
5th mess.	Warrenized meat in right-hand cooker. (This is to be cooked in hot air without water)	20 men.
6th mess.	Ten meat puddings in top right-hand cooker	20 men.
	Total ..	120 men.

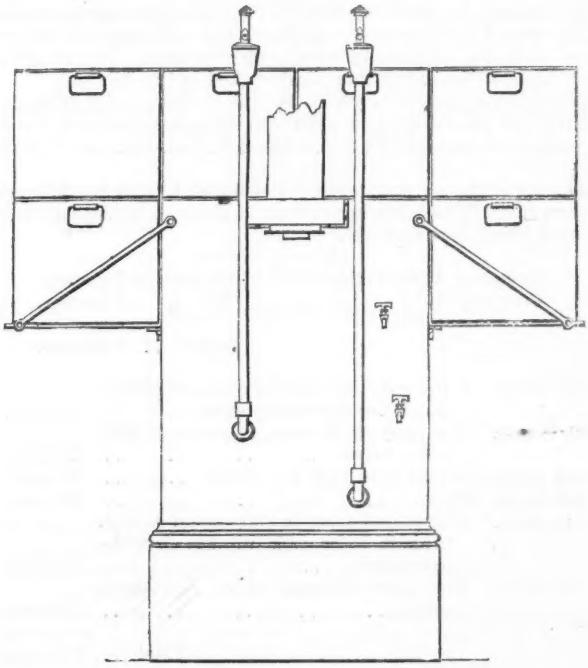
"In addition, 120 lbs. potatoes are cooked simultaneously in the potato steamer. A dish, termed a sea-pie, consisting of meat and paste in layers, can also be prepared in the top cookers.

"The total consumption of fuel for the day for 120 men will be found to average under 28 lbs. Thus a constant daily variety in cooking is obtained, which no system has given before, and this, as will be seen by the reports, at a greatly reduced consumption of fuel."

To fix the apparatus, place the loose stand D upon the ground, in the exact position in which it is intended the apparatus should be fixed; the body A A is then to be lifted upon it; it must then be tilted up at the back, and the ash-pit slid into the grooves under the bottom of the body, and then screwed to the front of the stand with the two screws which are attached to it.

Lay the furnace bars inside the furnace, then put on the two doors C and D—the former with the lining inside, is the furnace door—the latter, without a lining, is the ash-pit door; then screw in the two draw-off cocks J J_4 with a little red and white lead cement.

FIG. 2.



At the back of the stove (Fig. 2) are two brass screws to which the feeding pipes are to be attached—the longer pipe for the lower screw, the shorter pipe for the upper; these only require to be screwed up hand-tight; the brass feed cups are to be screwed on to the top of the two pipes, and the covers, which are constructed with whistles, should be placed upon them; then screw in the two small gauge-cocks into the holes at the back.

The smoke box is to be placed at the back of the stove, and secured with the two screws; from this, the smoke-pipe may be attached and carried into a flue in any manner most convenient.

The cookers are then to be placed on the stove in the following order:—

The two meat and soup cookers for the top, marked E E, will be known by their having inlets for the steam in the bottoms.

The two potato steamers F F are single-bodied cookers, with six perforated pots inside, and are to be placed on the shelf on the left side, the brass ferrule in the side fitting closely on the cone projecting from the side of the apparatus.

Having concluded the descriptive account of the apparatus, we will now proceed to the reports sent into office from time to time, since the experimental trials at Aldershot, which led to its adoption.

REPORTS.

No. I.

HORSE GUARDS, S.W., *4th March*, 1868.

Sir,—With reference to your letter of the 29th December, I have the honour, by desire of His Royal Highness the Field Marshal Commanding-in-Chief, to forward a copy of a report by a Board of Officers, assembled at Aldershot, to ascertain the saving in fuel, and the reduction in the waste of meat, effected by the process now termed "Warrenizing."

I have the honour to be, Sir,
Your most obedient servant,
E. R. WETHERALL, *Deputy Q.-M.-Gen.*

Captain Warren, R.N., Leicester House, Gipsy Hill, S.E.

(Copy.)

Proceeding of a Committee assembled to examine and report on Capt. Warren's Cooking Apparatus, as directed in Horse Guards' Memo., B/b/3808, of the 30th December, 1867.

Members.

Dr. Bacot, Staff Surgeon Major.
Capt. Home, D. A. Q.-M.-General.

The Committee having met, the following points for investigation were agreed on, as being not only embraced in the directions contained in the Memo. above quoted, but also as being interesting and desirable subjects of investigation:—

A.—The time of cooking.
B.—The quantity of fuel used.
C.—The quality of the food when cooked.
D.—The general adaptability for use by soldiers.

1st EXPERIMENT.

The meals for an entire company, 47 men, were cooked in Warren's Apparatus and in the usual Deane's boilers and ovens.

1st Experiment.

	A. Warren.	Deane's boiler.
Breakfast—		
Coffee	45 minutes.	20 minutes.

	Warren's.		Deane's.	
Dinners—	h.	m.	h.	m.
1 Mess soup..	3	35	3	45
1 Mess stew and potatoes				
1 Mess baked meat and potatoes				
Teas—				
Tea	1	45	1	45
Total	6	5	5	50

B.—*Fuel.*

	lbs.	oz.	lbs.	oz.
Breakfast	6	0	7	0
Dinners	15	8	61	0
Tea	1	8	3	0
Total	23	0	71	0

1 lb. of wood for Warren's Apparatus.
3 lbs. do. for Deane's do.

Note.—Coal used, a very fast burning inland coal. The allowance for 47 men is 50 lbs. of coal.

C.—*Quality of Food cooked.*

In both cases the food was excellent.

D.—*General adaptability for soldiers.*

This apparatus will cook for 120 men; but, allowing a certain margin, it will cook for 100 easily, and will allow of five different messes being cooked in distinct ways, which, in a sanitary point of view, is very valuable. Its use is easily learnt. It is quite safe, easily kept clean, shows dirt to an Inspecting Officer rapidly, can be easily moved from place to place, being in fact, a kind of stove; is less often out of order, and although its repair is more expensive, yet it requires fewer repairs and costs to keep it up about the same as Deane's apparatus, and costs far less in putting up and fitting into a cook-house, and takes for the number cooked for, about one-half the labour to work it.

2nd EXPERIMENT.

Two legs of mutton of the same weights, cut from the same sheep, were cooked—one in Deane's boiler, the other in Warren's apparatus.

	Warren's.			Deane's.		
	lbs.	oz.	dr.	lbs.	oz.	dr.
Weight of mutton before cooking ..	7	12	0	7	12	0
Do. when cooked	5	3	4	5	5	0

In the tin with the Warrenized leg of mutton there were 2 pints 15¾ oz. of very strong broth, fit for immediate use, while the water in which the other leg was boiled would have required a large expenditure of fuel and extra ingredients to have made soup at all eatable. The two legs were tasted by several persons, and the universal opinion was that the Warrenized leg was more juicy and better eating than the boiled leg.

With the view of testing still further the value of the process of Warrenizing, the liquor drawn from Captain Warren's apparatus was allowed to cool, and the water in which the leg was boiled was evaporated until it equalled in weight the former and then allowed to cool. It was found that the liquor from Captain Warren's apparatus gave 13 oz. of grease or fat, and the other 7 oz., the former yielding about ½ pint of *very strong* essence of meat, the latter yielding a poor and watery liquor.

Surmise of these results.

	Warrenized.	Boiled.
Weight of mutton cooked	5 3 4	5 5 0
Fat or grease	0 13 0	0 7 0
	6 0 4	5 12 0
	½ pint of strong essence of meat.	2½ pints of poor liquor.

To determine the saving with different varieties of food that can be made by the use of Capt. Warren's apparatus, would require very lengthened and exact experiments with appliances not at hand.

The following results of the experiments may be recapitulated:—

1. Great saving of fuel.—The Warren Apparatus, with 25 lbs. of inland coal, will cook for 100 men, the allowance for the same number of men being with Deane's Apparatus, 62½ lbs., and with that quantity, baking can only be performed about once a week. Taking all into consideration, and at the lowest calculation, this apparatus will save, perhaps, one-half of the fuel allowed at present.
2. Saving of labour in attendance.
3. Saving of labour and expense in putting up and fixing in cook-houses.
4. A saving of food in an eatable form.
5. An improved quality of food.

(Signed) J. S. W. Bacot, *Staff Surgn. Major.*
(Signed) R. Home, *Capt., D. A. Q.-M.-G.*
Approved.
(Signed) J. Yorke Scarlett, *Lt.-Genl. Comg. Division.*

No. II.

Horse Guards, S.W., *6th March*, 1868.

Sir,—I am directed by His Royal Highness the Field Marshal Commanding-in-Chief, to acknowledge the receipt of your letter of the 28th ult., and to transmit copies of reports received from Colchester, Portsmouth, and Dublin, as to trials of your Cooking Apparatus.

I am to refer you to letter from this office of the 4th instant, relative to recent experiments at Aldershot.

I have the honour to be, Sir,
Your most obedient servant,
E. R. Wetherall, *Dy. Q.-M.-Gen.*

Captain Warren, R.N.,
Leicester House, Gipsy Hill, S.E.

(Copy.)

Royal Barracks, *Dublin*, *8th July*, 1867.

Sir,—I have the honour to return the enclosures received with your communications of the 7th and 15th May and 26th June last; and in forwarding the accompanying reports upon Captain Warren's Patent Cooking Apparatus, tried by the 48th Regiment at Richmond Barracks, Dublin, to observe that I am of opinion that it is the best cooking apparatus I have seen, as it combines much variety in cooking, with less waste and more nutriment in the food cooked.

I would beg to recommend the following additions to the apparatus, viz.:—

1. Proper tin dishes made to fit the oven for baking; the barrack tin dishes now in use are smaller than the space allowed in the oven, consequently a less quantity is baked than could be.
2. Tin cans for tea or coffee, with lids, to keep the liquid hot until required; those now in use are the barrack water-cans—cans without covers.
3. An extra potato-steamer—the number in use allows only 1 lb. of potatoes per

man to be prepared; in some regiments the men wish to have 1½ lb. per man for dinner, which is the case in the 48th Regiment.

4. I would also recommend the best Welsh coal to be issued for this apparatus; the common kind of coal has been used, and there is no doubt that coal in Dublin is universally inferior to what is supplied in England, therefore 30 lbs. per diem is now necessary.

I have, &c.,

(Signed) A. S. CUNINGHAME, *Maj.-Gen., Com. Dublin Div.*

The Deputy Quartermaster-General, &c., Dublin Castle.

RICHMOND BARRACKS, *Dublin, 1st July*, 1867.

Sir,—I have the honour to make the following report upon one of Captain Warren's Cooking Apparatus, which was handed over to the regiment under my command for trial, and which is found to work very satisfactorily.

The trial commenced on the 7th June, 1867, and 84 men's rations (all the men not on guard of 2 companies) were cooked, but in consequence of the apparatus not being in working order, being quite new, 50 lbs. of coal were consumed, and the oven did not work well, the meat taking five hours to bake properly.

2nd day.—A similar result; the steamer worked very well indeed, and the dinners were cooked splendidly; but again, the oven on this day would not work well, consequently the baked dinners could not be served at the usual dinner hour (1 o'clock), and were not properly cooked until 2 o'clock.

As, however, I thought that there might be some defect in the putting up of the apparatus, it was taken down and placed in different position relative to the draught in the cook-house—the consequence was, the oven worked very well indeed, although 40 lbs. of coal were used on this day.

From the 3rd day's cooking no difficulty whatever has arisen in the preparation of the men's food, although a few pounds of coal more were used than allowed by Captain Warren.

From inquiries, I find the men's food is better cooked by this apparatus than by any other that has come under my observation, and that the meat loses less of its nutriment in the cooking. The men are mostly in favour of the stews prepared by it.

Although after the first three days it will be seen by the diary of the Sergeant Cook that on an average over 5 lbs. of coal were consumed daily over and above that laid down by Captain Warren, yet I am of opinion, that if 25 lbs. of good Welsh coal were used for the apparatus it would be found quite sufficient; the coal used during the trial was ordinary sea coal, and perhaps not of a first class quality.

However, I am confident that the apparatus has succeeded in a wonderful way in preparing the men's food at such a small cost of fuel, and it can be easily worked by one man.

There is one defect which, I think, could be remedied; the apparatus for steaming potatoes is not sufficiently large; soldiers are very fond of potatoes, and generally have (in my regiment) 1½ lb. per day; now, this apparatus would not cook, say for 120 men, 180 lbs. potatoes.

I think that this suggestion should be attended to, in order that a greater quantity of potatoes may be cooked.

After having given the apparatus a fair trial, I find the following results obtained:—

1. The cooking of the meat is better done, and it loses less of its nutriment than by any other apparatus that I have under my notice.

2. A greater variety of cooking is obtained than by any other apparatus which has come under my observation.

3. The very great saving of fuel. I am therefore of opinion that Capt. Warren's apparatus is the best that has been tried by my regiment.

I beg to append the report of the quantity of food cooked by the apparatus from 7th to 30th June, 1867.

I have, &c.,

(Signed) JOHN G. R. APLIN, *Col. & Lt.-Col. Comg. 48th Regt.*

(Copy.)

48TH REGIMENT.

Detail of Cooking done in the above Corps with Warren's Patent Apparatus, from 7th to 30th June, 1867.

RICHMOND BARRACKS, *Dublin.*

Dates.	No. of Messes.	No. of Men.	No. of Bakes Men.	No. of Stews Men.	No. of Soup Men.	lbs. of Potatoes.	Gallons of Coffee.	Gallons of Tea.	Gallons of Hot Water.	Fuel consumed.		Remarks.
										Wood.	Coal.	
7	5	84	24	14	46	90	16	16	12	1	50	The bakes not cooked at 2 o'clock. In oven 5 hours.
8	5	87	24	17	46	100	17	17	14	1	48	
9	5	87	24	17	46	100	17	17	14	1	40	
10	5	86	24	16	46	100	17	17	14	1	35	
11	5	86	23	17	46	110	17	17	14	1	33	
12	5	87	23	17	47	110	17	17	14	1	30	The bakes not cooked properly.
13	5	87	24	16	47	100	17	17	14	1	30	
14	5	87	25	17	45	100	17	17	14	1	30	
15	5	86	24	17	45	100	17	17	14	1	30	
16	5	85	26	16	43	100	17	17	14	1	29	
17	5	85	26	16	43	100	17	17	14	1	30	
18	5	87	24	16	47	110	17	17	14	1	31	
19	5	87	25	17	45	110	17	17	14	1	31	
20	5	87	26	16	45	110	17	17	14	1	30	
21	5	87	24	17	46	110	17	17	14	1	30	
22	5	86	25	16	45	100	17	17	14	1	32	
23	5	86	26	16	44	100	17	17	14	1	30	
24	5	85	26	59	0	100	17	17	14	1	31	
25	5	86	28	17	41	108	17	17	14	1	32	
26	5	86	27	18	41	100	17	17	14	1	30	
27	5	86	28	17	41	100	17	17	14	1	33	
28	5	86	26	18	42	98	17	17	14	1	30	
29	5	87	28	18	41	110	17	17	14	1	30	
30	5	87	29	18	40	108	17	17	14	1	31	
	120	2,070	609	443	1,018	2,474	403	403	334	24	786	

(Signed) E. SPARROW, *Sergeant Cook.*
„ JNO. KNOX, *Qr.-Master 48th Regiment.*

(Copy.)

A. A. M. GENL.

Report herewith—

I quite agree with Col. Aplin in his opinion of this cooking apparatus. It is the most complete arrangement of its kind I have seen, and its results in cooking are very satisfactory, while the saving effected in fuel is of great moment.

I have already reported (in my confidential reports of regiments lately inspected) that the allowance of coal (½ lb. per man) is insufficient for cooking with the present apparatus—that is, it is not sufficient to admit of *baking;* but under Capt. Warren's arrangement there is a saving of 16 per cent. on the otherwise insufficient allowance, and yet the baking is accomplished.

I agree also with Col. Aplin in pronouncing the food to contain more nutriment than when cooked by the ordinary process.

The soup I tasted was excellent.

I believe that with the addition of a third steamer sufficient potatoes might be cooked.

In the event of the boiler becoming corroded, I presume that there would be a way of cleaning it!

(Signed) M. McMurdo, *Br.-Gen.*

2—7—67.

(Copy.)

11 Depôt Battalion, *New Barracks, Gosport, 14th June*, 1867.

Sir,—Captain Warren's cooking apparatus has been in use with the battalion under my command from the 15th May to the present date.

I have therefore, the honour to report that I consider its cooking properties vastly superior to the one in use, "Deane's."

The men's dinners are more varied; they have bakes, roasts, stews, soups, hashes, suet dumplings, or vegetables. The meat is more juicy, and all descriptions of dinners are nicer in flavour. The gravies are richer, being entirely free from adulteration.

The cooking tins are so well arranged that neither water or steam can interfere with the food.

(150) One hundred and fifty men can have on any day their three meals satisfactorily prepared with 28 lbs. of coal, and by the addition of two cooking kettles, which could be placed on the top of the apparatus, its cooking capacity would be increased from 150 to 180, or 200 men, if requisite, without additional fuel.

I have, &c.,

(Signed) Q. Nason, *Lt.-Col. Com. 11th Depôt Battn.*

The Asst. Quartermaster-General, &c., Portsmouth.

B/170.

Portsmouth, 16th June, 1867.

With reference to your Minute of the 6th May last, I submit for the consideration of His Royal Highness the Field Marshal Commanding-in-Chief the report of Colonel Nason, commanding the 11th Depôt Battalion, on the merits of Warren's cooking apparatus, which appears to be very satisfactory.

(Signed) George Buller, *Lt.-Gen. Com. S. W. Div.*

To the Quartermaster-General of the Forces, &c.

Captain Warren's Cooking Apparatus.

4th Depôt Battalion, *Camp Colchester, 26th June*, 1867.

Forwarded to the Quartermaster-General in obedience to the directions contained in his Minute of the 22nd instant. The cook in charge of this apparatus is enthusiastic in his praises of its good qualities, and I must say from what I have seen of it, that the plan is excellent as well as economical.

(Signed) T. H. Tidy, *Col. Com. E. Dist.*

Sir,—With reference to the Quartermaster-General's Minute Paper, dated Horse Guards, 22nd instant, B/1807, calling for a report on Captain Warren's cooking apparatus, which has now been on trial in the 4th Depôt Battalion since the 15th instant, I have the honour to forward herewith a diary of the cooking done with it, and to submit the following as the result of the trial, so far as I have been able to ascertain at present:—

1. The men like it far better than Deane's, and think their meals more evenly cooked and better in flavour, particularly the tea and coffee.

2. There does not appear to be any likelihood of the meals being burnt or otherwise spoilt by ordinary inattention on the part of the cooks, an evil of frequent occurrence under other systems of cooking.

3. The maximum allowance of fuel, 25 lbs. per company of 100 men will, as a general rule, be amply sufficient.

4. The meals of a company mess, or any less number of men, can be kept warm after being thoroughly cooked without deterioration or inconvenience, or interfering with the preparation of evening meal for about two hours, and this without additional expenditure of fuel.

5. The Sergeant-Cook reports most favourably of the apparatus, which he considers in all respects the best he has ever seen in use.

I would beg to suggest the addition of two extra centre tins for the upper boilers, to be used exclusively for tea and coffee; this would be a great improvement.

I have, &c.,

(Signed) GEORGE COXON, *Major Com. 4th Depôt Bat.*

The Major of Brigade, Camp, Colchester.

4TH DEPÔT BATTALION, CAMP COLCHESTER, 25TH JUNE, 1867.

Diary of Cooking done in Captain Warren's Cooking Apparatus, at Camp Colchester, from 15th June, 1867, until 24th June, 1867.

Date.	Breakfast. No. of Men.	Teas.	Dinners.								Coals.		Wood.	Remarks.
			Baked Meat and Potatoes.	Baked Pies.	Baked Meat only.	Soup.	Stews.	Meat Puddings.	Sea Pies.	Potatoes.				
June, 1867											lbs.	ozs.	lbs.	
15th	72	72	..	37	..	35	..	..	..	42	26	4	1	
16th	70	70	..	35	..	..	35	..	..	35	26	0	1	
17th	71	71	..	..	..	..	35	36	..	35	23	0	1	
18th	71	71	..	..	..	..	..	35	36	..	23	0	1	
19th	69	69	16	..	..	18	..	..	35	35	25	0	1	There has been about eight gallons of water drawn out for washing up plates, basins, and cooking utensils daily.
20th	69	69	36	..	..	..	..	..	33	42	25	0	1	
21st	72	72	..	..	27	..	..	10	35	27	23	10	1	
22nd	49	49	..	7	..	..	..	..	42	..	20	0	1	
23rd	51	51	..	..	42	..	..	9	..	42	19	7	1	
24th	51	51	..	9	..	..	..	..	42	..	18	12	1	
Total ..	645	645	52	88	69	53	70	90	223	258	230	1	10	

(Signed) GEORGE COXON, *Major Commanding 4th Depôt Battalion.*

HORSE GUARDS, *November 12th*, 1866.

Sir,—With reference to your letter of the 5th inst., to the Lieut.-General Commanding at Aldershot, I am directed by the Field-Marshal Commanding-in-Chief, to acquaint you that it is conjectured from the experience gained in working your cooking apparatus for 100 men at Aldershot, that it would require from 35 to 40 lbs. per diem to cook for 200 men.

I am, &c.,
E. R. WETHERALL, *Dep. Quar.-Mast.-Gen.*

To Captain Warren.

Briefly, the result obtained is to cook the daily rations of 100 men in a greatly improved and varied manner, at a cost of fuel of 3*d.* per diem.

It would take up too much of your valuable time to go into the tabulated results obtained at the Paris Exhibition, where the apparatus was shown as the Army Apparatus, and obtained a medal; it is enough that the Paris Commissioners remark that—

"The patent cooking apparatus invented by Captain Warren, and manufactured by William Adams and Son, of Marshall Street, Golden Square, London, exhibited by the maker in the English testing-house, and by Her Majesty's Secretary of State for War in the exhibition of Barrack Fittings, &c., is one of the most important objects of this nature in the Paris Exhibition. This object places within the reach of the British soldier the means of eating his food prepared in a way which far surpasses anything to be met with in any other army. By some unfortunate circumstance, the Jury (judging by their awards) failed to appreciate the peculiar excellence and originality of these apparatus. Had their labours extended over a longer period, so that they might have witnessed the trials to which they were subjected, there can be no doubt that very different awards to those given, would have been received by the inventors."—(*Reports*) *Paris Commission.*

I shall conclude these remarks with a comparative statement of the saving effected by this system over that now in use.

The allowance for cooking is as follows, at home:—

1. When the old pattern boiler is used, 1 lb. of coal per man per diem.

2. Where the new, or Deane's boilers are in use, ½ lb. of coal per man per diem.

The home establishment shows a total number of no less than 136,000 men as in the pay of Her Majesty, exclusive of those on the Indian Establishment.

Allowing for married non-commissioned Officers, and rank and file married with leave, and others married without leave, but who are permitted to live out of barracks with the consent of their Commanding Officer, and are consequently also out of mess, a reduction of 25 per cent. (a far larger percentage than really exists), it would leave 102,000 single men to be cooked for daily at (taking the average of 1 and 2) ¾ of a lb. of coal daily.

Thus—

Coal for 102,000 men at ¾ lbs. per diem = 76,500 lbs.
Coal at same rate for same number of men for 365 days .. .. .. = 12,461 tons.

Same service (100 men being cooked for with 25 lbs. of coal)—

Per diem..	25,500 lbs.
Per annum	4,155 tons.

At home it is usual to take the average cost of coal in calculations of this nature at £1 1*s.* per ton. Thus :—

Present system—12,461 tons	=	£13,084 per annum.
Warren's— 4,155 tons	=	£4,362 per annum.
Difference		£8,772 per annum.

These figures are based entirely on the published reports.

The item No. 3 (saving of labour and expense in putting up and fixing in cook-houses) in the Committee's Report, marked No. 1, is a very considerable charge, the details of which can only be obtained by a special report; the saving, however, in purchase, fitting and repairs (*vide* Report 1.) will be fully 50 per cent. per annum over the present system of boilers and ovens, and the gross saving to the country by the adoption of Warren's apparatus, including fuel, would be at the lowest estimate from £16,000 to £20,000 per annum, in addition to a saving of labour in attendance, a saving of food in an eatable form, and an improved quality of food.

In conclusion the following extract from the *Morning Star* on a trial at the Society of Arts, may be interesting :—

"*Morning Star.*"—*Dec.* 14.

"CAPTAIN WARREN'S SYSTEM OF COOKING.

"A large number of ladies and gentlemen attended at the Society of Arts yesterday to witness a practical demonstration of Captain Warren's system of cooking for the Army and other large bodies of men. After inspecting Captain Warren's Patent Cooking Apparatus in one of the small rooms of the house, and listening to explanations by the patentee, the company were invited into the lower hall, where were laid out in banqueting style, soups, meats, fowls, vegetables, and other inviting condiments, cooked both according to the ordinary and the 'Warrenized' systems. The company were invited to partake of both specimens of cookery, and come to their own conclusions. They complied with much apparent gusto. In the course of the rather novel proceedings, Captain Warren explained the object he had in view, namely, to obtain economy in preparing food, and economy in fuel. With respect to the first, he had a letter from Mr. Haynes, on behalf of the Committee of the West Kent General Hospital, which stated :—

"'Captain Warren's system reduces the usual loss in cooking from one-third to one-fourth. The figures for two months at this Hospital are as follows :—Old method, meat bought, 959lbs.; waste, 343lbs. Warren's method, meat, 959lbs.; waste, 214lbs., showing a saving of 129lbs. of meat in two months.' This result was mainly at the hospital or at Aldershot by what was now called 'Warrenizing' the meat. It was cooked in such a way that nearly all its juices were retained, and the food was thus rendered not only more sweetened and nourishing, but much more palatable. Taking the experience of the hospital as a basis, if a family of seven persons took daily from the kitchen 10lbs. of meat, the saving of 2oz. per lb. would be 10d. per diem, 5s. 10d. per week, £15 4s. a year. Calculations based upon the trial at Portsmouth, which was conducted in a most searching manner by command of His Royal Highness the Duke of Cambridge, would produce results of an astounding nature if this mode of cooking were adopted by the public; the gain in a national point of view would be enormous. A few

figures will explain this. Thus it was found that 15lbs. of meat was reduced to 10lbs. 12oz. by the process in ordinary use in the kitchen of the Cambridge Barracks, while by Warren's system, the meat was reduced to 12lbs. 1oz., showing a gain of 1lb. 5oz. in each 15lbs. of meat. Now, if instead of cooking for a company of soldiers, we suppose that we are cooking for the 30,000,000 of people that compose this nation, and allowing the consumption of meat at 1oz. per head per diem, and the cost at 8d. per lb., the saving in money would amount to £2,750,000 per annum. With respect to economy of fuel, he had a report of what took place in Paris on the 20th of May last, at a trial for the express purpose of testing the apparatus in that respect. In that trial 16lbs. of coals cooked as follows:—Round of beef roasted, two ribs of beef baked, two legs of mutton 'Warrenized,' two hams steamed, two rounds of beef steamed, soups, potatoes, and vegetables. The apparatus could be readily applied to household purposes on the existing ranges, and at no greater cost, where boilers were already fitted, or where hot plates existed, so that it would be as efficient on a smaller scale in private houses. The saving of fuel would be not only individually, but in the aggregate very large. Taking the average cost of consumption for cooking purposes during the summer months alone, when fires for heating are not required, at 6d. per diem, which Captain Warren said he found was the charge made in lodging-houses, and he believed that might be taken as a fair price, representing 56lbs. of coals at £1 per ton, when that quantity was reduced to 28lbs. it would show for 750,000 houses a saving of £1,700,000 in fuel during that period, or about the cost of one half-year of our Abyssinian expedition. With respect to that expedition, the Captain stated that the weight of the apparatus supplied for practical use was only 146lbs., and they could be transported on the backs of mules or horses. The company seemed to approve very much of the joints and dishes prepared by the apparatus, especially those which were Warrenized."

The CHAIRMAN, on returning the thanks of the meeting to Captain Warren (whose unavoidable absence they all regretted) for the interesting paper just read, said that he felt bound to mention the name of one who had been the pioneer in the way of army cooking, and to whom all thanks were due, he referred to Captain Grant, R.A.

Captain Grant returned thanks to General Lindsay and the company for the manner in which his name had been received. He could only add that he had gone carefully into Captain Warren's mode of cooking for troops, and that he had a very high opinion of it.

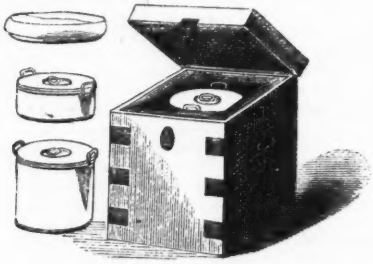
The following provisions cooked in Captain Warren's range were served up to the audience after the lecture, and were by them pronounced to be excellent:—

1 Leg of mutton,	8 lbs.	weight,	"Warrenized,"	put in	cooker	1.35,	taken out 3.45
1 "	7½	"	Roast	"	roaster	1.45,	" 3.50
1 Fowl			Roast	"	roaster	2.30,	" 3.40
							and kept hot
1 Ditto			"Warrenized,"	"	cooker	2.30,	" 3.40
							and kept hot
1 Piece of Bacon	4	"	"Warrenized,"	"	cooker	1.0,	" 3.50
5 Quarts soup, made with	5 lbs.	beef, herbs, &c.				12.0,	" 3.50
14 lbs. Potatoes			Steamed	"		2.0,	" 3.0
							and kept hot

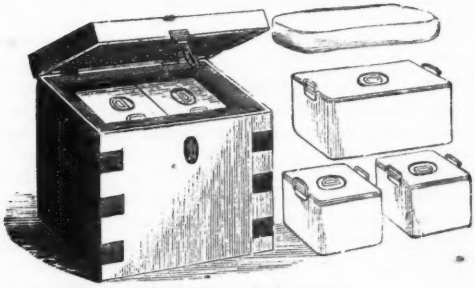
Weight of coals used, about 20 lbs.

At the close of Captain Warren's lecture on cooking for troops, Monsieur Johan Sörensen briefly explained the principles of his "Norwegian self-acting cooking apparatus" as follows:—

The principle on which this cooking apparatus acts is, that of retaining the heat, and it consists of a heat retainer or isolating apparatus shaped somewhat like a refrigerator, and of one or more saucepans or other cooking vessels made to fit into it.



With Round Saucepans.



With Oblong Saucepans.

In the ordinary way of cooking, the fire is necessarily kept up during the whole of the time required for completing the cooking process, the same result, however, is obtained in using this apparatus, by simply giving the food a start of a few minutes' boiling, the rest of the cooking being completed by itself in the heat-retainer away from the fire altogether.

To use the apparatus, put the food intended for cooking with the cold water or other cold fluid, as the case may be, into the saucepan, and place it on the fire. Make it boil, and when on the point of boiling, skim if required. This done, replace the lid of the saucepan firmly, and let it continue boiling for a few minutes. After the expiration of these few minutes, take the saucepan off the fire, and place it quickly into the isolating apparatus, cover it carefully with the cushion, and fasten the lid of the apparatus firmly down. In this state the cooking process will complete itself without fail. *By no means let the apparatus be opened during the time required for cooking the food.*

The length of time during which the different dishes should remain in the isolating apparatus, varies according to their nature. It may, however, be taken as a general rule that the same time is required to complete the cooking in the apparatus, as in the ordinary way on a slow fire.

The following dishes, prepared in Mr. Sörensen's apparatus, and placed in the boxes at the times specified, were then served up, and pronounced by the company to be excellently cooked and of excellent flavour :—

Beef Steak Pudding.		Irish Stew. Fowl, with Rice. Potatoes.	
Put on the fire at	10.35	Put on the fire at	11.5
Reached boiling at	10.50	Reached boiling at	11.33
Put into the apparatus at ..	11.0	Put into the apparatus at ..	11.40

Leg of Mutton.

Put on the fire at	9.30
Reached boiling at	10.3
Put into the apparatus at	10.10

The following are the advantages which Mr. Sörensen claims for his apparatus :—

1st. Economy in Fuel.—This varies according to the length of time required for cooking the different sorts of food. For those requiring, in the ordinary way, only one hour's cooking, the saving is about 40 per cent., two hours 60 per cent., three hours 65 per cent., six hours 70 per cent. In the case of gas being used, the saving would be still greater.

2nd. Economy of Labour.—As above stated, no sort of food requires to boil on the fire more than a few minutes (rich puddings might, however, require more boiling), and once in the isolating apparatus, the cooking will complete itself unattended to. The industrious housewife may, for instance, in the morning employ the same fire which has served for preparing the family breakfast, to cook the dinner; she may then extinguish it, and be at liberty to look after her other domestic duties, and even leave the house, without further care about the kitchen. No fear of burnt dishes, no fear of the food boiling over, no danger of fire, because there is none. When the hour of dinner is at hand, she opens the apparatus, and will infallibly find the dinner ready, as the cooking in the apparatus is completed with mechanical regularity. The food prepared in the apparatus will, however, never be overcooked and may remain in it three or four times as long as is required for completing the cooking, without getting cold or losing any of its nutritive qualities or good flavour. This is explained by the fact that the food is almost hermetically enclosed in the apparatus, and consequently not exposed to the evaporation which would occur in the ordinary way of cooking. The apparatus will keep the food sufficiently hot for from twelve to twenty hours, according to size.

3rd. Portability.—The self-acting cooking apparatus are made in all dimensions, and in many different forms; there are specimens with a single saucepan, holding from one gallon to three gallons, and others with two and three saucepans, containing together from one to five

gallons. Besides these, which are always on hand, others are made to order, containing three, four, or five saucepans, and still larger ones for one cooking vessel, containing from five to twenty gallons, specially adapted for use in barracks, hospitals, merchant vessels, ships of war, transport and emigrant ships, arsenals, poorhouses, prisons, asylums, and similar public establishments. The weight of the apparatus complete, varies from 18 to 50 lbs. All these apparatus can, in proportion to their dimensions, be carried about with great facility, without interfering with the cooking process. By means of a large apparatus, for instance, following on a cart a detachment of soldiers on the march, it is possible to provide them with a hot meal at any moment it might be found convenient (as may be proved by official reports from the officers of the Royal Guard, at Stockholm, in the possession of the patentee).

Again, fishermen, pilots, and others whose small vessels are not generally so constructed as to enable them to procure hot food while at sea, may easily do so, by taking out with them in the morning an apparatus prepared before their departure. It is, in short, a thing for the million, for rich and poor, for the domestic kitchen as well as for persons away from their homes; it cooks, and keeps food hot, just as well when carried about on a pack-saddle, on a cart, or in a fisherman's boat, as in a coal-pit or under the kitchen table.

4th. Quality of the Food Prepared.—A dish prepared with water or other liquid, and requiring three hours for cooking in the ordinary way on the fire, loses by evaporation from 20 to 25 per cent. in quantity. As part of this loss necessarily consists of nutritious substances, it is readily to be understood that the food cooked in the ordinary manner on the fire loses considerably in nutritious strength. By employing the self-acting apparatus nearly all evaporation is avoided, and consequently the loss of nutritious matter is almost imperceptible. It is for this reason that stewed dishes, soups, vegetables, fruits, coffee, and more or less all food prepared in this apparatus, will be found to have a most agreeable and aromatic taste.

5th. Simplicity of Use.—One of the greatest advantages of this invention is, no doubt, its simplicity and practical application. There is no complication of hot water or air pipes to retain the heat, no mechanical combination whatever for producing a high degree of heat by steam pressure; consequently there is no necessity for steam valves or other combinations which would render the use of the apparatus difficult and dangerous. Any person will, without difficulty, be able to use the apparatus to advantage after once having witnessed it in operation. No special arrangement is required in the kitchen for using the apparatus. Any fuel will do for starting the cooking.